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THE QUARTERLY REVIEW *of* BIOLOGY

EMBRYOLOGY AND EVOLUTION: NINETEENTH CENTURY HOPES AND TWENTIETH CENTURY REALITIES

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ABSTRACT

An attempt is made to assess the influence of evolution theory on the study of embryology by examining the assumptions held by embryologists before and after the publication of the Origin of Species, and by questioning to what degree any change in these assumptions has been fostered by concepts of evolution. The assumptions considered are the following: (1) assumptions about embryology: (a) that the study of development is important; (b) that developmental phenomena are open to investigation; (c) that morphology remains of primary significance in interpretations of development; (2) assumptions about embryos: (a) that multicellular organisms are produced by eggs; (b) that development is epigenetic in so far as one step in development is a necessary condition for the next; (c) that the cell is the developmental unit of the organism; (d) that the molecule is the developmental agent within the cell.

It is suggested that while Haeckel's emphasis on development in the grand evolutionary scheme of things was instrumental in stimulating the study of development and in convincing his readers that its problems are soluble, his most important influence was through his whole outlook on nature rather than through the recapitulation doctrine itself. Haeckel's emphasis on the importance of morphological criteria in support of recapitulation may have been to some extent detrimental to the immediate progress of embryology, as was his opposition to the physiological interpretations of Wilhelm is and thus to a fertile study of epigenesis. Mid-twentieth century interest in development as related to spontaneous generation and as a part of molecular biology has grown out of lines of thought separate from those of classical evolution theory.

It is concluded that many of the most important working assumptions of the embryologists of today developed independently of classical evolution doctrine.

INTRODUCTION

EVOLUTION and development have had much to do with each other for over two centuries: and the history of the very words by which we name them attests to their long interinvolvement. The word *evolution*:—EVOLUTIO—was in general use from the middle of the 18th century to describe one aspect of what we consider development, namely, what we now call preformation. As to the other side of the coin, during the 19th century, before what we call evolution had received its habitual appelation, it was called the Development Hypothesis in English; and as Ernst Mayr (1959) has recently reminded us, *Entwicklungsgeschichte* was used in German to describe both the development of the individual and that of the race.

Herbert Spencer is usually given credit for introducing the word *Evolution* in its present sense, and it is often emphasized that Darwin himself did not use it in the *Origin of Species*. Actually, the last

word in the *Origin of Species* is "evolved," used in exactly our present sense.

The 19th century in fact saw *Geschichte*—history—come into its own: and all these concepts, which involve the assumption of *change*, had some profound common philosophical basis (Temkin, 1950). We have the feeling now that change is accelerating in human affairs; perhaps the rush made itself felt already during the last century.

It is in a way a tribute to the power of Haeckel's ideas that the words "evolution and embryology," chained together in a phrase, still, after the middle of the 20th century, bring the recapitulation theory to mind first of all. I shall not, however, concentrate on the recapitulation doctrine alone. Too much has already been said about it. Kohlbrugge (1911), as I have recently reminded a different group of readers (Oppenheimer, 1959), in 1911 published a list of 72 authors—and at that the list is incomplete—who between the years 1797 and 1866 expressed concepts akin to Haeckel's recapitulation doctrine, and any one who wishes a catalogue of these ideas can turn to Kohlbrugge's essay. For a modern discussion of the recapitulation doctrine, the third edition of *Embryos and Ancestors* by DeBeer (1958) is now available. This author brings together evidence from many sides to demonstrate that Garstang's (1922) phrase *ontogeny causes phylogeny* is a much more appropriate slogan than Haeckel's *phylogeny causes ontogeny*. DeBeer's study does not, however, take full cognizance of the contributions of modern developmental genetics towards the support or the modification of the old recapitulation theory, and it is to be hoped that soon a new synthesis which goes beyond DeBeer's will incorporate this relevant new material.

Being unwilling myself to focus my remarks on the recapitulation doctrine *per se*, I wish to try to evaluate in another way the influence of the Darwinian evolutionary concepts on embryological thinking. A scientist can proceed to his work only if he has in his mind certain assumptions, which, if he is a thoughtful scientist, he recognizes as assumptions, not as axioms nor demonstrated principles. What I propose to attempt is an examination of the assumptions made by the embryologist, or other investigator of what we call development, before the publication of the *Origin of Species*, and after, in the hope that a comparison will reveal how deeply or how superficially the concept of evolution has affected the body of working assumptions of the embryologist, and thus shed light on the question raised in my title, namely, whether the hopes of the 19th century investigators for a synthesis on the common ground shared by evolution and embryology have been fulfilled by the work of nearly a century. "Development," wrote Haeckel, "is now the magic word by means of which we shall solve the riddles by which we are surrounded" (quoted from Rádl, 1930, pp. 126–127). Has his prophecy been fulfilled? And if so, how much of the credit for its fulfillment belongs to Haeckel?

ASSUMPTIONS OF THE EMBRYOLOGIST

Let us start out by trying to become clear as to what we mean by assumptions. Assumptions are not hypotheses that the investigator tries to test in his laboratory. In science, one man's findings do not become an assumption for the next man, they are merely something whose validity may be tested. Assumptions are something taken so much for granted that their validity is rarely questioned, and it does not often occur to the scientist to verify them. Perhaps the mark of the really great scientist is that he takes less for granted than others and goes back beyond the assumptions for his starting point. Von Baer's so-called Laws, which embryologists still live by today, were not assumptions for him, they were derived from his evidence; his assumptions lay deeper, actually, nurtured by the fantasies of nature philosophy.

The validity of von Baer's laws, as conceived by himself, has recently been denied by an important philosopher of biology (Lovejoy, 1959) but the laboratory embryologist must disagree with the latter.

But that is too far back in the 19th century. Here, there are two kinds of assumptions with which we must concern ourselves, assumptions about embryology itself, as well as those about embryos, and the nature of the first set affects that of the other group.

Assumptions about embryology as a science

First, for embryology. We assume, I believe, that embryology is both interesting and important. But it was hardly always so. Haeckel himself had something to say about this. "The embrology of organisms occupies in the present,"

he wrote in 1875, "a position very different from that in the first half of our century. This science, although the youngest of its sister sciences, has in a very short time soared to a height which is not merely prominent but actually dominating. Still a rather isolated specialty of a few naturalists a few decades ago, embryology has with unprecedented progress become a universal science, and has stimulated an intellectual movement that has sent forth its waves to the farthest reaches of human knowledge" (translated from Haeckel, 1875, p. 1).

It can easily be documented that Haeckel was correct in that embryology developed its importance during the middle of the 19th century. It is also probably safe to say that Haeckel's emphasis on embryology in relation to evolution was an important factor in influencing this development. What is not so certain is that the recapitulation doctrine itself played the dominating role in this influence. Many investigators, and developmentally oriented ones at that, attest to the stimulus they received from Haeckel's writings, Spemann and Goldschmidt among them. Goldschmidt, for instance, wrote of his first exposure to the ideas of Haeckel: "I found Haeckel's history of creation one day and read it with burning eyes and soul. It seemed that all problems of heaven and earth were solved simply and convincingly; there was an answer to every question which troubled the young mind. Evolution was the key to everything and could replace all the beliefs and creeds which one was discarding" (Goldschmidt, 1956, p. 35). In other words, what inflamed Goldschmidt was Haeckel's whole synthesis of everything from inorganic matter to organism, from carbon to the soul of man—his concept of the unity of nature, his whole *Weltanschauung*, not the mere fragment of it which he termed the biogenetic law.

Spemann's statement supports the same interpretation. He wrote of reading *Die Seele des Kindes*, by Wilhelm Preyer, and continued: "That came from the realm of Ernst Haeckel, who led into biology so many young men of my generation and of the previous one. There too I met for the first time the concept of biology as an all-embracing science of life, with teachings stirring it to its last depths" (Spemann, 1943, p. 116).

Goldschmidt's comment, in particular, brings us to our next assumption about embryology, as fundamental as the first. This is that developmental phenomena are investigable. They are to be analyzed, at least in some degree, not only admired. This too, like our first assumption, was not commonly held by all before the time of Darwin.

For instance, see what the *Encyclopedia Britannica* said of generation in its 1842 (7th edition) article on Physiology:

"The immediate agency by which one living being is rendered capable of giving rise to another similar to itself is enveloped in the most profound and most hopeless obscurity. No means within the compass of our understanding, no combination of the powers of matter which we can possibly conceive, no process of which the utmost stretch of human imagination can give us the most remote idea, has ever made the least approach towards the solution of this most inexplicable of all enigmas, the production, nay, the apparent creation, of a living plant or animal by powers inherent in the organization of a similar being. We must content ourselves, in studying this inscrutable mystery, to observe and generalize the phenomena, in silent astonishment at the marvelous manifestation of design and of power exhibited in this department of the wonderful works of the Almighty" (anonymous article "Generation," *Encycl. Brit.*, 1842, 7th ed., vol. 17, p. 684).

To what degree was it the influence of Haeckel that led to the alternative assumption, that the problems of development are soluble? Goldschmidt has already answered the question for us. Haeckel believed that the riddles of the universe were in fact solved during the 19th century, and his so-called explanations were so simple, so dogmatic that he easily swept his readers into the conviction that all was explained or explicable. This new conviction that development was capable of being understood—on whatever basis—may have been more important for the progress of embryology than that the basis on which Haeckel explained it was recapitulation. To this degree, the sequel to evolution was responsible for a new outlook in developmental science.

But in how far was evolution alone responsible for it? Allen Thomson, who wrote the article on Generation in Todd's *Cyclopedia of Anatomy and Physiology* (1836–39), answers for us: "It is a common remark that generation is at once the most obscure and the most wonderful of the processes occurring in organized bodies. Hence,

perhaps, it has happened that, while there are few subjects of physiological inquiry upon which so many authors have written, there is none upon which so many have freely indulged their fancies in framing unwarranted hypotheses and absurd speculations. This is an error which belongs to the early stage of investigation in most branches of natural knowledge, and which in the instance before us may be traced very directly to the comparative want of correct information which for a long time prevailed regarding the phenomena of the generative processes. . . . When extended observation shall have rendered more familiar to the physiologist the different steps of the intricate processes by which an egg is formed, and the young animal is developed from it, although he may not cease to admire the changes in which these processes consist, the feeling of wonder will be in a great measure lost to him. . . . The man of science regards the ultimate causes of all vital processes as equally inexplicable, and, aware of the bounds set to his knowledge of life, limits his inquiries concerning its various processes to the investigation of their phenomena" (Thomson, 1836–39, p. 426).

In other words, many years before the publication of the *Origin of Species* and of Haeckel's commentaries on it, it was clear that sober laboratory scientists, independent of the great generalizers, were initiating laboratory investigations that might soon have sufficed to send tottering the assumption that developmental phenomena are beyond investigation.

One more assumption we make about embryology as a science: I believe that even now we many of us find it difficult not to assume that embryology is a morphological science. Haeckel himself made this same reproach to his predecessors and contemporaries, and coined a number of words for the physiological aspects of development that he hoped would be investigated. But even in our own days, when chemical embryology has won its ascendency over anatomical study, the goal of the chemical and biochemical investigation is often expressed as the explanation of structure. That is, the structure seems to be the main thing, to be accounted for by something else.

Of course form is the most essential attribute of the developing organism. But it is a dynamic form, in which the molecules and molecular systems constituting and developing structure are as important *as* the structure, and perhaps to be explained *by* structure as much as explanatory *of* it. Is not this the essence of that elusive property, embryonic organization?

Our inabilities to free ourselves from some of our unconscious bondage to over-static concepts of morphological structure we inherit from the early days of the welding of embryology and evolution. Haeckel was a morphologist, he was a structural biologist, and we still suffer from the fact that though he talked about physiogeny he drew his evidence from structural form. Haeckel would not admit that what His was thinking was physiology, by the way. He said of it that explaining ontogeny in its own terms was like Munchhausen pulling himself out of the swamp by his own pigtail (Haeckel, 1875, p. 20). Thus the facts that Haeckel drew too sharp a distinction between form and function instead of viewing them as part and parcel of one another, and that he therefore led his followers to study recapitulation through a formal study of structure, may have been as important in dictating the assumptions of modern embryology as that he returned to a specific theory of recapitulation that had already been expressed and taken issue with before his time.

Form was important for the nature philosophers who preceded Haeckel; it was Goethe, after all, who coined the word morphology (Goethe, 1807, p. 115). But if my interpretation is correct, it was Haeckel who made static structure rather than dynamic form the stock in trade of the developmental biologist, and this may be construed as having been a great disservice to developmental biology.

Assumptions about embryos

Now let us turn to some assumptions that are less related to how we study, more to what we think; less of *-ology*, more of *-ogeny*.

The first thing we assume about embryogeny is that development occurs, that is, that the embryo is generated by the egg. "The life of an animal may be said to start from the egg which has just been fertilized," is the way DeBeer (1955, p. 1) puts it. Agassiz and Gould (1848, p. 103) said that it is an "old adage" of zoology that all animals are produced by eggs. In fact, we do more than assume it, we consider it a demonstrated principle that eggs make multicellular organisms, that organisms are not being spontaneously generated on our earth at this time. This was not yet a general assumption

at the time that the *Origin of Species* was published. In 1859, Pasteur had not yet completed his experiments. It should require no emphasis here that Pasteur's thought was far from being influenced by concepts of natural selection, recapitulation, or even evolution more generally.

Actually it is only a very recent flare of interest in evolution which is restoring respectability to concern with spontaneous generation, and by many spontaneous generation is considered as compatible with, even necessarily related to, concepts of evolution and development. What is responsible for this new enthusiasm? Partly our recognition of continuity between inorganic and organic, which is very old, far older than formal evolutionary doctrine. Since we accept that the organic evolved from the inorganic (and Oparin, 1957, gives due credit to Haeckel for his naive notions on this subject), evolution is somehow involved. But is this the kind of evolution which is directly related to recapitulation? Some of the evidence may be interpreted *in terms of* recapitulation, but that is something different. It seems to me most unlikely that the recapitulation doctrine carried to its ultimate extreme could alone have led to the modern attempts to explain the origin of life. The lines of thought that led to the development of modern biochemistry originated from points far distant from those with which we are concerned.

We also assume, having assumed development, that development is epigenetic, and since the days of von Baer we are convinced that something new comes from something old. Shortly after the Darwinian period an assumption of causality crept into our concepts of epigenesis (though to be sure it had been creeping in and out of them for centuries). His (1874) stated specifically that one step in development is the cause of the next, or at least its necessary condition. He was laughed down by Haeckel who marshalled all the evidence from recapitulation to ridicule him. The formulation of our principal working assumption of today was thus not only not favorably influenced by, but was most vigorously opposed by, the proponents of evolutionary embryology.

Now again, we are not so sure that the concept of epigenesis is as simple as it once seemed; we must worry about molecular precursors in differentiation; about whether or not enzymes are induced, and if so, how; about DNA as a hereditary determiner. The real problem of causality, in so far as the 20th century still admits the concept of causality, is related to the materials with which genetics deals. But again, the lines that led to the development of genetic concepts came from Mendel, not Darwin, and were not in their origins influenced by concepts of evolution except in the remotest sense. Mendel was not concerned with phylogeny, nor even with embryos.

I suspect that many will question my interpretations of what our assumptions are in embryology, in fact I question some of them myself, they are still very tentative. But I believe it is safe to say that if anything is assumed by developmental biologists, it is that the cell is not only the structural and functional unit of the organism, but its developmental unit as well. The aggregationists and disaggregationists are I believe not questioning whether or not the cell has a role in development, they are attempting to elucidate what its role is. Now, the cell theory was being developed at the same time that Darwin was working out the arguments later to be incorporated in the *Origin of Species*; the development of the concept of the cell as a unit of the organism was on the whole simultaneous with the development of the concept of natural selection. But these concepts developed quite independently of one another at the outset. Before the second half of the 19th century, developmental biologists not only did not consider the cell the unit of development, they were not thinking in terms of units at all. The assumption of units was a 19th century addition to the concept of development; Wolff's and von Baer's layers were agents of development without having the unitary value that was later to be ascribed to the cell.

Both the cell theory and the evolution theory were synthesizing and unifying doctrines for biology, and to this degree they were useful to each other. But which most gave support and which most received it has, I believe, never been fully evaluated. Darwin never mentioned cells in the *Origin of Species* (though Haeckel was to make the most of them). And Virchow, who put the important finishing touches on cell theory, was critical of some aspects of Darwinian theory, and became a famous anti-Haeckelian, though not, to be sure, on developmental grounds alone.

Now, for a final word about our developing

assumption that the molecule is the developmental agent with the cell, which begins to dominate the minds of contemporary developmental biologists. We look to the molecule, many of us, to account for the structure of the cell. Surely this concept has received its latest stimulus for growth from biochemistry, not from evolution theory, and the same remarks are relevant here as were made above concerning the related assumptions on spontaneous generation and the origin of life. General concepts that the materials of which living and nonliving entities are composed obey similar laws reach far back into antiquity and have been expressed off and on for millennia. It was hardly Haeckel's commentary on them that brought about the development of modern biochemistry; the French medical physiologists who were Haeckel's contemporaries and others who were similarly unconcerned with evolution may have had much more to do with it.

CONCLUSIONS

How, then, do we answer our question as to whether development has solved the riddles by which we are surrounded, with evolution as the clue? This was the 19th century hope, what is the 20th century reality? The outstanding contribution of 20th century embryology remains, to my mind, the analysis, incomplete though it still is, of the relationships between embryonic parts at a cellular or supracellular level. It is something new that developmental biology no longer confines itself to the materials which the 19th century thought proper to embryology, and is expanding its domain to include considerations of pathological, immunological, serological, biochemical—the biophysical ones have unfortunately been neglected—cytological, and genetic phenomena, as well as those which we might call physiological in our sense, not Haeckel's. In drawing together data collected by these various techniques of investigation, it is becoming central in our core of biological thinking, of which Haeckel would have approved. But in so changing, it has raised new problems rather than solving the old ones.

Consider, for instance, the problem of growth and differentiation of proteins. If organisms are to grow and differentiate, proteins must grow and differentiate. Their development has been related to the properties of ribonucleic acids. The properties of ribonucleic acids have been postulated as related to the properties of deoxyribonucleic acids. Establishment of the structure, function, and organization of deoxyribonucleic acids thus becomes a developmental problem. The properties of DNA have their developmental effects, as do the properties of RNA, and those of proteins, and of formed cell inclusions, small and large, nuclear and cytoplasmic, as do indeed the properties of the cell itself. By calling attention to the fact that these various entities participate in development, the study of development should theoretically elucidate them. Practically, it is barely beginning to do so.

Those who are more directly occupied than I with molecules may disagree, but I believe that their great day as developmental biologists is ahead of them, not yet in the present or past. The nucleic acids so important to present-day concepts are so far better understood on a genetic than on a strictly developmental basis, unless *all* of the phenomena of genetics are to be comprehended in developmental biology, and to make this exaggerated claim might be as foolhardy as it was to omit developmental phenomena from the study of genetics, as was so long the practice.

To this extent, development is not the magic word that either Haeckel considered it or that some modern biologists might wish it to be. At the risk of being as rash as Haeckel, I should like to say, however, that it has the capacity and promise still of becoming it. And when some great developmental biologist rises above our present concern with the concomitants of development, and learns to frame an answerable question as to the manner in which the developing organism as a whole progressively in time *organizes* its constituent developmental and concomitant processes, there will prove to have been some magic in having emphasized development after all.

To return to the question of Haeckel's responsibility for our emphasis on development: we admit that his enthusiasm for embryology was a factor in developing the popularity of the subject as a discipline. But I for one believe that the important contribution of Haeckel in this respect was primarily his desire and pursuit of the whole, not his emphasis on recapitulation. And I personally believe that many of our most important working assumptions of today developed independently of classical evolution

doctrine, in so far as anything could be independent of it after its promulgation. [Embryologists cannot forget that Roux's first major contribution (Roux, 1881) was based on an analogy between the interaction of embryonic parts and the struggle for existence of organisms in nature.]

I have pointed out elsewhere (Oppenheimer, 1956) the difficulties of agreeing upon a body of principles of embryology in the present state of our science. Perhaps developmental biologists are working too hard at attempting to express principles. When the principles are valid, they speak for themselves: the principle of progressive differentiation, for instance, has asserted itself so convincingly it requires no developmental biologist nor historian to speak for it. Perhaps we should leave the striving for formulation of principles momentarily aside, and instead examine our assumptions more often, not only for the light they may shed on or have shed on them by history, but for the sake of the scientist at work, who can interpret his findings with maximum validity only when he knows how much of his thinking about them is based on hope that his assumptions are justified, and how much on what, in his own temporal frame of reference, seems to be reality.

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THE EVOLUTION OF THE DACETINE ANTS

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ABSTRACT

A preliminary synthesis of evolutionary studies of certain morphological and ethological characters in the ant tribe Dacetini is given. A primary trend inferred from the study of living species is the shift from epigaeic-subarboreal to cryptic-terrestrial foraging. Possibly associated in the early stages of dacetine evolution with this shift was a trend toward oligophagous predation, resulting in extreme cases among modern forms in specialized feeding on collembolans. Secondary changes have occurred in hunting behavior and in a diversity of morphological features; these are described briefly. Reversed or, more accurately, "countercurrent" evolution has occurred in various phyletic lines in most of the characters of this morphological-ethological coadaptive system. Such changes are relatively short-range and usually involve only a few characters at a time. In at least some instances they have produced a local reversal in the overall dacetine trend to specialization, as with secondarily increased polyphagy in some species of Strumigenys. *Convergence to the higher dacetine morphological type has occurred independently in several other ant tribes; in at least one case* (Rhopalothrix) *ethological convergence is also evident.*

INTRODUCTION

In recent years, we have witnessed a spectacular rise in interest in comparative studies of animal behavior. Many of these studies have attempted to relate behavior of given species or higher taxa to their particular environments, to the morphology and physiology of the animals, to their systematics, and to their evolutionary history. Certainly, the integration of all these approaches should be a principal goal of the modern investigation of any group.

One important group of animals that is especially favorable for such an integrated study is that of the ants. These insects form a distinct family, the Formicidae, in the Order Hymenoptera, or wasp-like insects. The ants are still incompletely known and are rather unsatisfactorily classified, but we believe that, with more than 10,000 species and several hundred genera already described, they are roughly comparable in diversity to a taxon such as the class Aves.

As is implied by their placement among the Hymenoptera, the ants arose (apparently during the Cretaceous) from some group of wasps, probably solitary wasps allied to the living Tiphiidae. The existing ant species are all social; that is, parent adults and their offspring of all developmental stages live together in groups, called colonies. In most species the colonies inhabit more or less definitely structured nests in the soil, in plant cavities, etc. During most of the year they are composed entirely of females, which are normally divided into two basic castes, the queens and the workers, which tend to be specialized for different functions. Males appear in the colonies at certain seasons, and are important only in sexual reproduction.

The fact that nearly all human cultures have a common word meaning "ant" is a tribute to the abundance and ubiquity of these insects over the temperate and tropical parts of the earth. Their great numbers and relatively high activity rates place them among the really important transformers of energy in terrestrial environments. It is again their exceptional abundance, as well as the ease with which they may be found and cultured in the laboratory, that renders ants ideal subjects for biological study.

The most primitive ants, like their wasp ancestors, feed their larvae on many kinds of insects that they capture on plants or on the ground surface, while the adult workers themselves gain a large part of their nourishment from nectar or other sugary substances for which they forage on plants. In higher groups of ants, feeding is often more specialized. Some kinds

forage almost entirely on the trunks or foliage of trees, where they may tend plant lice for their honeydew, hunt insects, or both. Many types have become harvesters of seeds, and one group, the Attini, raises and eats fungi, thus engaging in the only well-established case of true crop agriculture except for that managed by mankind.

Other lines among the ants have developed predatory mass-foraging "army-ant" habits that have allowed them a wider choice of prey, while still others have evolved very narrow prey preferences, such as the *Leptogenys* which feed on sowbugs (Oniscomorpha), or the eyeless *Centromyrmex*, believed to capture termites in their subterranean passages. There is even one large group, the Cerapachyini, that lives by raiding the nests of other ants and feeding on their brood. To this category of specialist predators belong also the Dacetini, a tribe of nearly 200 known species belonging to the subfamily Myrmicinae, one of the nine major divisions of the Formicidae. We have not yet uncovered the relationships of the Dacetini to the other tribes of Myrmicinae; they form a phyletically isolated group, occurring mainly in the tropics and milder temperate regions of the earth. But enough is now known about them to make the Dacetini an especially instructive case history of group evolution.

In 1936 L. G. Wesson showed that the dacetine ant *Smithistruma pergandei* (Emery) has some remarkable peculiarities in its food-getting behavior. Workers of this species prey chiefly or exclusively on springtails (collembolans), which they capture by an elaborate maneuver including careful stalking followed by a sudden, trap-like closure of the mandibles. Wesson and Wesson (1939) showed that similar behavior is exhibited by a few other species of *Smithistruma* in North America. These early observations, which have been fully confirmed by later work, revealed *Smithistruma* as one of the most highly specialized of all ant genera of which the habits are known. *Smithistruma*, however, represents the end-product of but one phyletic line of the Dacetini. This large cosmopolitan tribe contains a rich diversity of genera, many of them clearly very primitive relative to *Smithistruma*, and others occupying intermediate or higher phyletic positions (Fig. 5). The Dacetini therefore provide excellent opportunities for the study of the phylogeny of predatory behavior. During the past ten years the present authors have been conducting such a study intermittently while engaged in laboratory and field work in the United States and in both the Old and New World tropics. The following paper constitutes a preliminary summing-up of the results of this effort. In it we have tried to sketch some of the evolutionary trends thus far noted and to show how much of major dacetine evolution can be interpreted as the outcome of a primary adaptive shift toward cryptic foraging that characterizes upper phyletic lines of this tribe. Of equal importance, we have attempted to indicate the large gaps remaining in our knowledge of this interesting group of insects. The possibilities for future research seem to be great, both for the evolutionist and for the physiologist interested in the analysis of stereotyped behavior.

In the descriptive parts to follow, it has been necessary to use several technical words ordinarily found only in rather specialized entomological and taxonomic literature. For the convenience of the general reader, some of these terms are briefly explained below.

Alitrunk. The central portion of the body of the ant (and other Hymenoptera), consisting of the true thorax and the first true abdominal segment, which is fused with it.

Epigaeic. Foraging in the open, whether on the ground or arboreally; contrasted with *hypogaeic*.

Foveate. Referring to integumental sculpture consisting of foveae, relatively large circular depressions with well defined margins, often bearing a hair on a central tubercle.

Funiculus. The series of segments of the antenna beyond the elongate first segment, or *scape*.

Gaster. The last major portion of the body; in dacetines the gaster follows the postpetiole and is composed of the fourth and succeeding true abdominal segments.

Hypogaeic. Foraging in hidden places, either within or beneath covering objects such as leaf litter, moss, or rotting wood (*cryptobiotic*), or deeper within the soil itself (*subterranean*).

Morphocline. A stepwise series of changing manifestations of a given character as followed through a group of related species, usually interpreted as the result of evolutionary succession.

Petiole. The first segment or node in the ant's "waist"; the second true abdominal segment.

Postpetiole. The second segment of the ant's

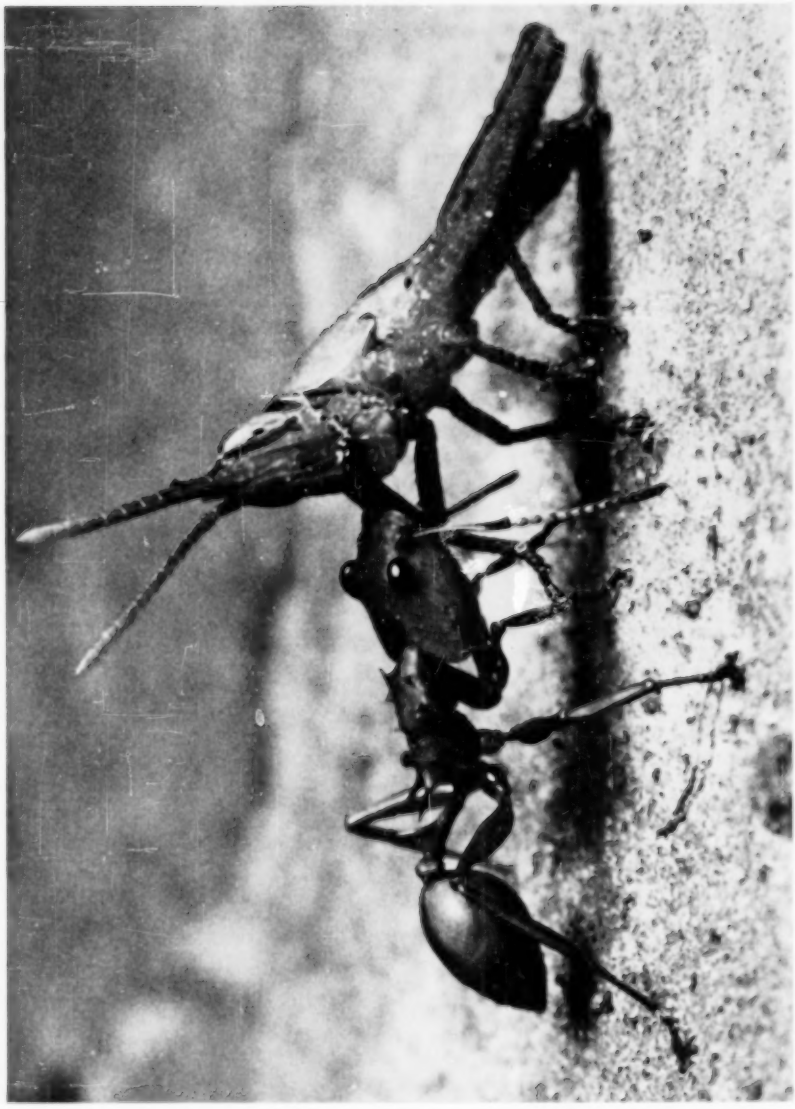


FIG. 1. *Daceton armigerum* (WORKER)

The large primitive dacetine is holding a small acridoid grasshopper it has just caught in its mandibles. About 10 × natural size, this remarkable photograph was taken from life near Pucallpa, Peru, by Dr. E. S. Ross. It constitutes the second known prey record for *Daceton*.

"waist" in groups, such as the Dacetini, possessing a two-jointed waist; the third true abdominal segment.

Puncturation. Referring to integumental sculpture consisting of punctures or small pits.

Scape. The elongated first (basal) segment of the antenna in ants and some other insects.

ECOLOGICAL SYNOPSES OF THE DACETINE GENERA

In the following section are listed all of the known subtribes and genera of the Dacetini, with very brief general statements concerning our present knowledge of their distribution and natural history. Most of these groups have been treated in more detail in the taxonomic and ecological papers cited at the end of the individual synopses. The number of species known in each genus is given in parenthesis (*n*) after the generic name.

Subtribe Dacetiti

Daceton (1). Neotropical. Tropical rain forest. Workers polymorphic, long-mandibulate. Nests in hollow tree trunks. Foraging epigaeic-arboreal. Food: tabanid fly (Brown, 1954a), small acridid grasshopper nymph (see Fig. 1); workers attend coccids on cacao (Bodkin in Crawley, 1916).

Acanthognathus (3). Neotropical. Tropical rain forest. Workers monomorphic, long-mandibulate. Nests in rotting logs. Foraging behavior unknown (Mann, 1922; M. R. Smith, 1944); Fig. 3.

Subtribe Orectognathiti

Orectognathus (13, including 2 undescribed). Australian-Melanesian. Warm-temperate and tropical forests. Workers primitively monomorphic, in one species secondarily polymorphic; long-mandibulate. Nests in soil and rotting wood. Foraging epigaeic, probably mostly subarboreal and nocturnal. Food: the single species studied (*O. clarki* Brown) accepted entomobryomorph and symphypleonan collembolans (Brown, 1953a, 1953b, 1958a); Fig. 4.

Arnoldidris (5). Papuan. Tropical rain forest. Workers monomorphic, long-mandibulate. Nests in soil. Foraging diurnal, chiefly subarboreal. Food: unknown. (Brown, 1958a); Fig. 2.

Subtribe Epopostrumiti

Epopostruma (6–8). Australian. Warm-temperate forest. Workers monomorphic, long-mandibulate. Nests in soil. Foraging epigaeic, terrestrial and subarboreal. Food: entomobryomorph and symphypleonan collembolans and sugary substances. (Brown, 1954a); Fig. 6.

Hexadaceton (1). Australian. Arid scrub. Workers monomorphic (?), long-mandibulate. Nesting and foraging habits unknown. (Brown, 1948, 1954a); Fig. 9.

Mesostruma (2). Australian. Arid scrub to tropical forest. Workers feebly polymorphic, with mandibles of intermediate length. Nesting and foraging habits unknown (Brown, 1952b); Fig. 7.

Colobostruma (including *Alistruma* and *Clarkistruma*) (13, including several undescribed). Australian-Papuan. Arid heath to tropical rain forest. Workers monomorphic, short-mandibulate. Nests in soil and rotting wood; one species (*C. alinodis* Forel) nests with species of *Rhytidoponera*. Foraging behavior diverse: some species are hypogaeic, others epigaeic and subarboreal; some of the latter are nocturnal. Food: in two cryptobiotic species studied, entomobryomorph collembolans. (Brown, 1954a); Figs. 8, 10, 11.

Microdaceton (2–4). Ethiopian. Workers monomorphic, long-mandibulate. Primarily forest-dwelling. Nesting and foraging behavior unknown.

Subtribe Strumigeniti

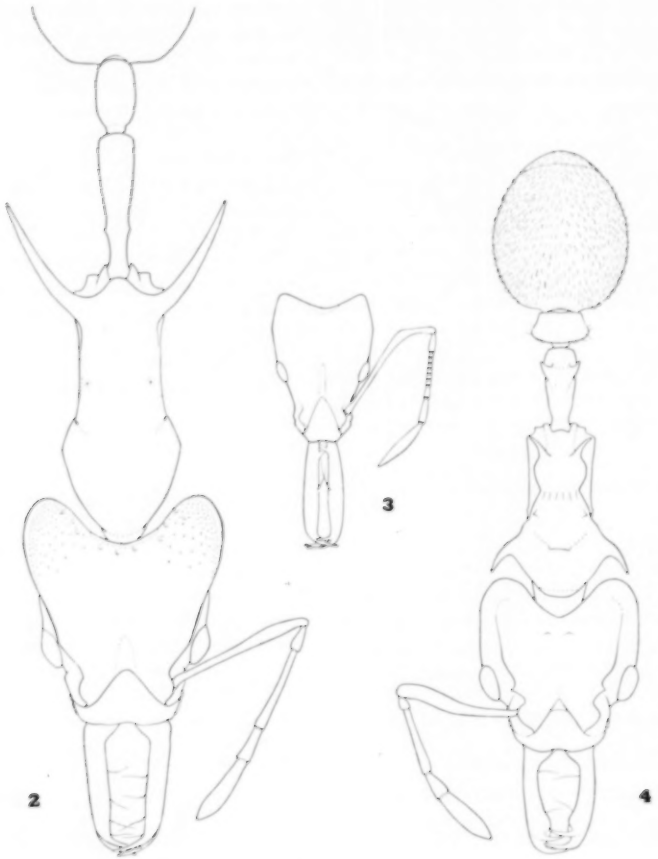
Strumigenys (including *Labidogenys* and *Pyramica*) (ca. 150). Widespread in tropics and warm temperate areas. Primarily forest-dwelling; some species occur in grassland and arid scrub. Workers monomorphic, in one species secondarily polymorphic; long-mandibulate. Nests mostly in soil and rotting wood; a few species live in arboreal plant cavities in tropical rain forest. Foraging hypogaeic to epigaeic-arboreal. Food: most species are collembolan feeders; a few are polyphagous predators (see below) or occasionally feed on sugary substances; one species (*S. xenos* Brown) is a workerless parasite. (Weber, 1939, 1952; Wilson, 1950, 1954; Brown, 1954a, 1954b, 1955); Figs. 12, 13, 17–21, 25, 26, 30, 31.

Quadristruma (artificial genus containing two species derived independently from *Strumigenys*; to be revised shortly). Workers monomorphic, short-mandibulate. One species, *Q. emmae* (Emery), is a pantropical tramp, nesting in rotting wood, coconut husks, soil, etc. Foraging behavior unknown. (Brown, 1949, 1954b).

Neostruma (6). Neotropical, mainly forest floor-dwelling. Workers monomorphic, very small, mandibles varying from short-intermediate to long. Nests in rotting wood in soil cover, including small chips. Foraging (*N. mustelina*) mostly cryptic, sluggish, with "ambush" tactics frequent; utilizes "strike-hold-sting" technique of prey capture. Food, so far as known, is entomobryoid Collembola. (Brown, 1948; a revision of this genus by Brown is being readied for press.) Figs. 14–16, 32.

Smithistruma (60±). Widespread in tropics and warm temperate areas throughout world except for Australia, New Zealand, and Chile. Mostly forest-dwelling. Workers monomorphic, short-mandibulate. Nests in soil and rotting wood; a few species live in arboreal plant cavities in tropical rain forest. Foraging mostly hypogaeic, with a few species presumably epigaeic-arboreal. Food: species range from strict collembolan feeders to polyphagous arthropod predators. (Wesson, 1936; Wesson and Wesson, 1939; Brown, 1953a; Wilson, 1954); Fig. 23.

Glamyromyrmex, Codiomyrmex, Codioxenus, Weberistruma, Borgmeierita, Pentastruma, Gymnomyrmex, Tingimyrmex, Miccostruma. This is



FIGS 2–4. SOME PRIMITIVE DACETINE GENERA.

Dorsal views, one antenna omitted in each figure. Fig. 2. *Arnoldidris szentivanyi*, worker, legs and posterior part of gaster omitted. Fig. 3. *Acanthognathus ocellatus*, head of worker. Note basal teeth of mandibles, in this genus used to carry the larvae, and the folded trigger hairs, here situated on the mandibles so as to erect and point forward when the mandibles are opened. Fig. 4. *Orectognathus phyllobates*, worker, legs omitted.

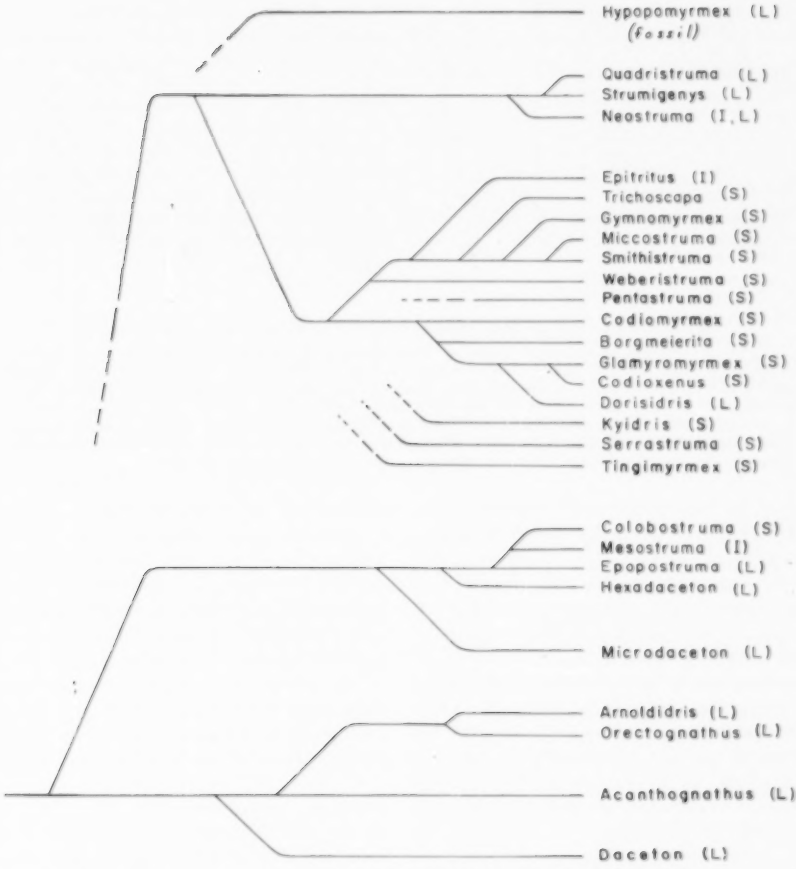


FIG. 5. PRESUMED PHYLOGENY OF THE KNOWN GENERA OF LIVING AND FOSSIL DACETINI
Letters in parentheses refer to kind of mandibles: L, long; I, intermediate; S, short.

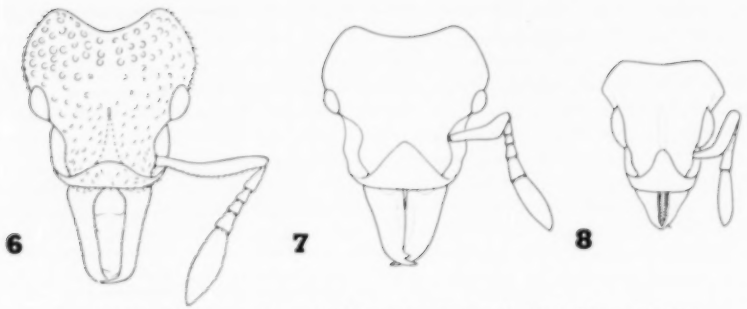
a group of genera related to *Smithistruma* and containing in the aggregate approximately twenty small, short-mandibulate, mostly tropical species. The natural history of these genera is very poorly known. (Brown, 1948, 1950, 1953a; Borgmeier, 1954): Fig. 22.

Dorisidris (1). (A long-mandibulate form derived from the short-mandibulate *Glamyromyrmex*). Cuban. Tropical deciduous forest. Workers monomorphic, long-mandibulate. Nests in soil or soil cover. Foraging behavior unknown. (Brown, 1950).

Trichoscapa (1). Widely spread by commerce through warmer parts of world, probably originating in Africa. Workers monomorphic, short-mandibulate. Highly adaptable, often living in cultured areas. Nests in soil, rotting wood, etc., often in relatively dry situations. Foraging hypogaeic. Food: polyphagous arthropod predator. (Brown, 1948, 1949; Wilson, 1954).

Serrastruma (4–6). Ethiopian-Malagasian. Highly adaptable, occurring from savanna to tropical rain forest. Workers monomorphic, short-mandibulate. Nests in soil and rotting wood. Foraging behavior unknown. (Brown, 1952a; Weber, 1952).

Epitritus (2). Mediterranean area and Japan. Workers monomorphic; mandibles intermediate in length, this condition apparently derived secondarily in evolution from short-mandibulate type. Natural history poorly known. (Brown, 1949, 1958b); Fig. 24.



FIGS. 6–8. EVOLUTION OF HEAD AND MANDIBLES IN THE SUBTRIBE EPOPOSTRUMITI

Heads of workers, dorsal view, right antenna omitted in each figure, sculpture and pilosity omitted in Figs. 7 and 8. Fig. 6. *Epopostruma* sp. Fig. 7. *Mesostruma turneri* (syntype); in this genus, mandibles basically of the *Epopostruma* type are shortened, broadened, and filled in by translucent lamella, through which the basic core shape is still visible. Fig. 8. *Colobostruma cerornata*, worker, the new inner mandibular margin has now developed serial dentition (compare with evolution of short mandibles in *Neostruma*, Figs. 13–15 and 30–33). Note the "countercurrent" development of huge eyes in this nocturnal, foilage-foraging species.

Kyidris (3). New Guinea and Formosa to Japan. Tropical rain forest and warm temperate forest. Nests in rotting wood. Workers monomorphic, short-mandibulate. The two New Guinea species are permanent parasites of *Strumigenys loriae* Emery. Workers show degenerate behavior: they do not participate in nest-building but do help their hosts with brood care and in foraging; in the latter task they are notably inefficient in comparison with the host workers. On the other hand, the parasite workers attend coccids within the nest, a function the host workers are not known to perform (Wilson and Brown, 1956).

EVOLUTIONARY TRENDS: BEHAVIORAL CHARACTERS IN THE COADAPTIVE SYSTEM

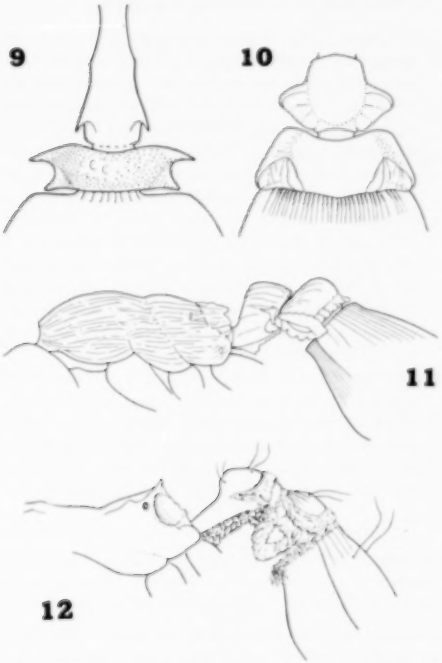
Since their origin, which presumably occurred sometime in the early Tertiary, the dacetine ants as a whole have shown an evolutionary tendency to shift from above-ground, subarboreal foraging to cryptic, chiefly terrestrial foraging. Such a trend is not unusual in the ants. It is also well marked, for instance, in the primitive tribes Ponerini and Ectatommini. Some previous authors (e.g., Haskins, 1939) have offered the interesting theory that this trend in the Ponerini has resulted indirectly from competition with more recently ascendant, dominant epigaeic groups in the Dolichoderinae and Formicinae. A similar explanation can be entertained with respect to the history of the Dacetini as against other myrmicines and the formicines, but the theme we wish to develop here is that this major adaptive shift, whatever its ultimate causation, has had a profound and pervasive influence on the course of evolution in the tribe. A number of major morphological and ethological characters have been greatly modified, apparently at least in part as a result of the change in foraging behavior. Together these form a relatively closely knit coadaptive complex of evolving characters. The specific ethological characters involved are the following:

1. *Change in hunting behavior.* The relatively primitive long-mandibulate forms rely greatly on the violent, trap-like action (Figs. 17–21) of their mandibles to secure prey, while their "approach period" toward prey is relatively short, and their use of the follow-through stinging thrust is not invariable. The short-mandibulate forms, on the other hand, have less shocking-power in their mandibles and rely more on stealth in approaching prey, in tenacity of grip following the mandibular strike, and in immediate, consistent, and efficient use of the sting. The essential features of this evolutionary change can be illustrated in the contrast between the behavior of *Strumigenys louisianae* Roger, a relatively primitive, long-mandibulate strumigenite and that of the phylogenetically more advanced, short-mandibulate *Trichoscapa membranifera* (Emery), as described by Wilson (1954):

> The *Strumigenys* are bolder and more direct in their manner of stalking prey. . . . This trait is perhaps a result of their more efficient mandibles,

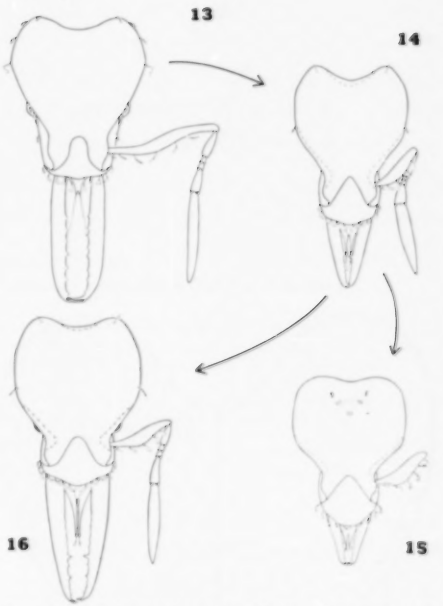
which are extremely long and supplied with prominent apical teeth. They can be opened to almost 180° and operate very much as miniature animal spring traps. [Note: Recently we have discovered that the mandibles are locked into open position when special teeth at their bases catch on the lateral labral lobes; see Figs. 17–21]. When approaching a collembolan, the worker *Strumigenys* moves slowly and cautiously, spreading its mandibles to the maximum angles and exposing two long hairs which arise from the paired labral lobes. These hairs extend far forward of the ant's head and apparently serve as tactile range finders for the mandibles. When they first touch the prey, its body is well within reach of the apical teeth. A sudden and convulsive snap of the mandibles literally impales it on the teeth, and drops of hemolymph often well out of the punctures. If the collembolan is small or average in size, the ant lifts it into the air [and then may sting it]. All but the largest Collembola are quickly immobilized by this action, and struggling is feeble and short-lived.

As soon as the [*Trichoscapa membranifera*] worker becomes aware of the presence of a collembolan,



FIGS. 9–12. INDEPENDENT EVOLUTION OF SPONGIFORM APPENDAGES IN THE TWO SUBTRIBES EPOPOSTRUMITI AND STRUMIGENITI

Fig. 9. *Hexadaceton frosti*, holotype worker, dorsal view of petiole, postpetiole and gaster. Fig. 10. *Colobostruma australis*, worker, same. Note the partial transformation of the postpetiolar teeth into submembranous alae; the smaller alae on the petiole have evidently arisen de novo, and the dorsal teeth of *Hexadaceton* have been lost. Fig. 11. *Colobostruma cerornata*, worker, side view of mid-section of body, showing the extreme development of spongiform appendages reached in the epopostrumite line. Fig. 12. *Strumigenys lacacoca*, worker, side view of mid-section of body, showing well-developed spongiform appendages of a type frequent in the strumigenite line. Evolutionary steps leading to the strumigenite appendages are unknown, but the steps represented by the epopostrumite species of Figs. 9–11 suggest one way they may have developed in the strumigenite line as well.



FIGS. 13–16. EVOLUTION OF THE HEAD, MANDIBLES AND ACCESSORY STRUCTURES IN THE GENUS *Neostruma*

Fig. 13. *Strumigenys jamaicensis*, worker, a member of the *S. gundlachi* group, ancestral to *Neostruma*. Fig. 14. *N. zeteki*, worker. Fig. 15. *N. metopia*, female, funicular segments of antenna omitted. Fig. 16. *N. myllorhapha*, worker. Right antenna omitted from each drawing. The paired labral lobes (between the bases of the mandibles) are short in *Strumigenys*, and the trigger hairs, which act as range-finders to set off the spring-snap action of the mandibles, are long. With the shortening of the mandibles in *Neostruma*, the labral lobes have extended and the trigger hairs have been reduced (Figs. 14, 15), presumably in order better to withstand damage from the violent struggling of the collembolan prey. In *N. myllorhapha* (Fig. 16), the mandibles are secondarily elongate, with the labral lobes further elongated to make up for the shortness of the trigger hairs. Note the correlated changes in length of the apical segments of the antennae in Figs. 13, 14 and 16.

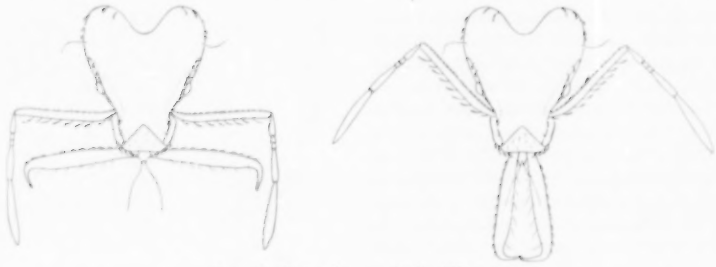


FIG. 17. *Strumigenys ludia* WORKER
Dorsal view of head, showing the mandibles in the open (left) and closed (right) positions.

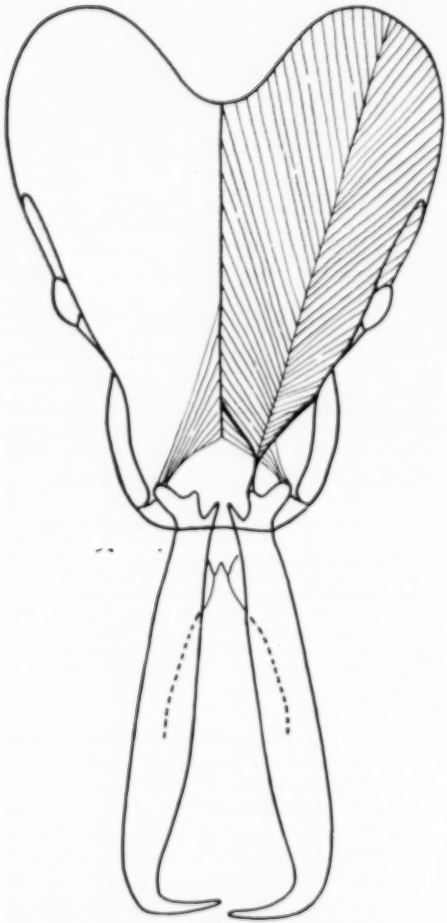
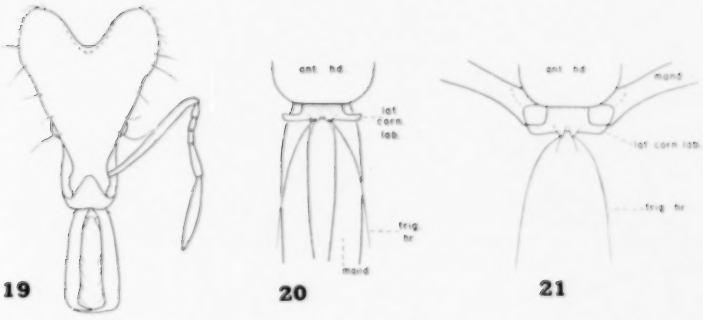


FIG. 18. *Strumigenys ludia* WORKER
Diagrammatic dorsal transparent view of head to show the approximate relationships of the mandibles to the muscles moving them. The large dorsal muscle is the left retractor, this has been removed on the right side to show the much smaller abductor muscle originating on the ventral midline of the head.

it "freezes" in a lowered, crouching position and holds this stance briefly. If the collembolan is to its back or side, the worker now turns very slowly to face it. Once it is aligned with the collembolan, it begins a forward movement so extraordinarily slow that it can be detected only by persistent and careful observation. Several minutes may pass before the ant finally maneuvers over less than a millimeter's distance to come into a striking position, and it may remain in this position for as much as a minute or more. . . . Unlike the *Strumigenys*, the *Trichoscapa* open their mandibles only to about a 60° angle. Tactile labral hairs are present and eventually come to touch the prey. The mandibular strike is as sudden as that of the *Strumigenys*, but since it is usually directed at an appendage, it does not have the same stunning effect on the collembolan. These insects often struggle vigorously to escape, but the ants are very tenacious and retain a fast grip until they are able to sting their prey into immobility.

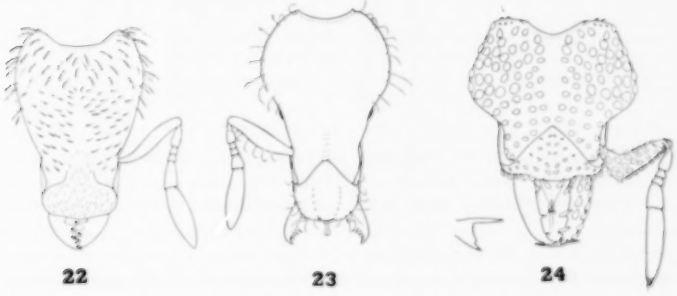
In summary, *Strumigenys louisianae* relies on a comparatively swift approach to its prey followed by a fixed-action pattern that can be characterized as *strike-lift-sting*, with the last element occasionally being omitted if the prey is small, while *Trichoscapa membranifera* employs a more cautious approach followed by *strike-hold-sting*, with the last element inevitable. It should be noted further that in *Trichoscapa* the stinging thrust follows the mandibular strike much more quickly and is apparently generally more effective than in *Strumigenys*. Both patterns, however, are individually effective in collembolan predation. The *Strumigenys* pattern is apparently typical for long-mandibulate dacetines generally, while that of *Trichoscapa* is typical for the short-mandibulate groups. The *Trichoscapa* pattern, requiring less space for the operation of the mandibles, is generally associated in the Dacetini with cryptic foraging.

Those dacetines that feed mainly on Collembola all show a relatively slow-motion,



FIGS. 19–21. THE TRAP-JAW APPARATUS OF A WORKER OF *Strumigenys bryanti*

Fig. 19. Dorsal view of head, right antenna omitted. The lateral cornuae of the labrum extend slightly beyond the lateral borders of the closed mandibles near their bases. Fig. 20. Ventral view of anterior part of head (ant. hd.) showing basal halves of closed mandibles (mand.), lateral cornuae of dropped labrum (lat. corn. lab.), and trigger hairs (trig. hr.). Fig. 21. Same, open position of mandibles. When the trigger hairs are stimulated, the labrum drops down and allows the tension of the retractor muscles to pull the mandibles shut with a snap.



FIGS. 22–24. REPRESENTATIVE HEADS OF SPECIES IN THE SHORT-MANDIBULATE STOCK OF SUBTRIBE STRUMIGENITI

Workers, dorsal views of head and mandibles. One antenna omitted in each figure. Fig. 22. *Codiomyrmex semicomptus*. Fig. 23. *Smithistruma weberi*, pilosity omitted, except for fringing hairs; the mandibles are open, and the tips of labral trigger apparatus are seen projecting from beneath the clypeus. Fig. 24. *Epitritus hexamerus*, pilosity omitted from right mandible in order to show dentition. Mandibular apex in end-on view shown in inset. The mandibles and labral lobes in this genus are secondarily elongate (compare with *Neostruma myllorhapha*, Fig. 16), apparently derived from the *Smithistruma* pattern.

stealthy stalk approach to their prey, as compared to non-dacetine ants (*Hylomyrma*, *Stenamma*) that we have found to feed to some extent on Collembola also. For protection against predators, entomobryomorph springtails rely first on the fleetness of their running and their extremely sensitive and nervous escape response to movements nearby. *Hylomyrma* and *Stenamma* usually charge a springtail in a clumsy rush, with mandibles open, and this approach rarely succeeds. The collembolan simply dashes to a new position. Dacetines, on the other hand, make so stealthy an approach that the collembolans often remain undisturbed until suddenly struck by the mandibles.

Once the ant has seized the prey, the second escape mechanism of the springtail comes into play—the furcula or kick-spring organ. Used under circumstances of more violent disturbance, the furcula can project the collembolan to a considerable distance, and this movement can be made several times in rapid succession. The spring may carry the springtail away from the ant, or, if the animal is large enough, it may carry a clinging dacetine with it in its leaps and thus make the ant's return to the nest a longer and more difficult trip. It is to the ant's advantage to neutralize the action of the furcula as quickly as possible. The *Strumigenys* accomplish this by lifting their prey clear of the ground with

FIG. 25. A *Strumigenys ludia* WORKER STINGING A SMALL ISOTOMID COLLEMBOLAN
The ant has caught the springtail with a convulsive snap of the mandibles, and having lifted it clear of the ground, it draws its gaster under and stings its prey to render it immobile.

their long mandibles, so that the furcula cannot contact the substrate and launch the animal. If the collembolan is not killed outright by the mandibular strike, it struggles, and the ant employs the sting by reaching all the way up to the springtail with its gaster (Fig. 25). The short-mandibulate forms must depend on immobilizing their prey with a quick sting. Often the collembolan is able to make several jumps before it succumbs, but the bulldog-like tenacity of the ants usually serves to carry them along until the poison acts.

We have noted on a number of occasions in different *Strumigenys* and *Smithistruma* species that the act of stinging, once the body flexion is begun by the ants, is carried through to "completion," i.e., to extrusion of the sting at full flexion, even though the collembolan may have escaped partway through the act. This suggests the "consummatory behavior" of the ethologists (Tinbergen, 1951).

It is a curious fact that poduromorph Collembola, despite their seeming helplessness and feeble locomotion, are not taken by any Dacetini so far studied. In fact, even polyphagous dacetines will show definite avoidance of such poduromorphs as they may meet, including those upon which they have made more or less accidental mandibular strikes. Indications are that poduromorphs are protected against many predators, including dacetines, by effective repugnatorial substances.

2. *Change in amount of locomotory activity during foraging.* As a rule, the short-mandibulate, cryptobiotic dacetines hunt over more limited foraging territories and are less active during foraging.

A POSSIBLE ADDITIONAL ETHOLOGICAL TREND

On the basis of limited evidence, the primitive species *Daceton armigerum* (Roger) appears to be a general predator on medium-sized insects. Many of the higher dacetine species, however, are narrowly restricted in their predation, accepting only entomobryomorph and symphyleonan collembolans and avoiding poduromorph collembolans and other arthropods. These predators include members of *Epopostruma, Colobostruma, Strumigenys,* and *Smithistruma.* Also

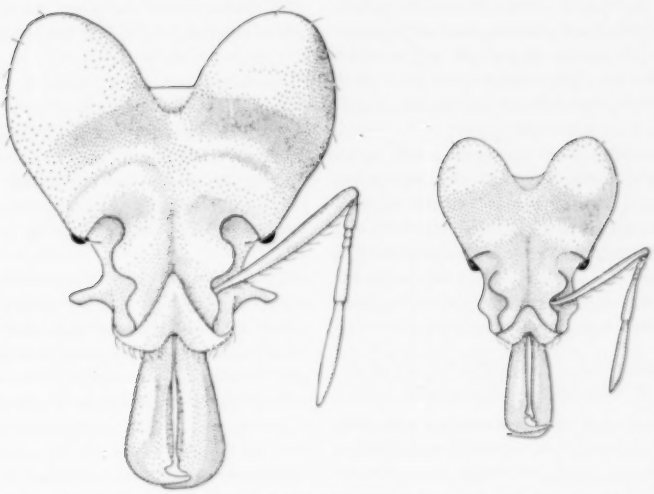


FIG. 26. *Strumigenys loriae*, SHOWING EXTREMES OF POLYMORPHISM IN THE WORKER CASTE FROM A SINGLE NEST SERIES
Note the allometric development of the mandibles and lateral genal tubercles.

the relatively primitive orectognathite genus *Orectognathus* appears, on the basis of laboratory tests made on one species (*O. clarki* Brown), to be specialized to feed on collembolans. A few species of higher dacetines, e.g., *Smithistruma clypeata* (Roger), accept a small variety of soft-bodied arthropods in addition to the preferred collembolans, but can still be safely classified as oligophagous predators. The species of higher dacetines that are known to be clear-cut exceptions to the rule of oligophagy are exceptional in other ways, to the extent that they may be distinguished as members of one of the three following special classes:

(a) Possessing a polymorphic worker caste. *Strumigenys loriae* Emery, a notably polyphagous form, is the only known higher dacetine with a distinctly polymorphic worker caste (Fig. 26). (b) Widely distributed, either naturally or as tramp species carried by man. *Strumigenys louisianae* Roger ranges as a native species from the southeastern United States to temperate South America, while *S. rogeri* Emery and *Trichoscapa membranifera* Emery occur widely through the warmer parts of the world as tramp species. (c) Occurring as a member of a depauperate insular fauna. *Strumigenys nidifex* Mann, perhaps the most polyphagous of all the higher dacetines, is an exceptionally large species endemic to Fiji. A cognate species found widely from Australia to the Philippines, *S. australis* Forel, is known to be a collembolan specialist (Brown, ms.).

It would seem that the above three peculiarities are linked in some way to the condition of polyphagy. We would like to suggest, hypothetically, that polymorphism has allowed in *Strumigenys loriae* the development of a large-headed major subcaste that can capture larger arthropods; that polyphagy has allowed the wide distribution of some species by opening up to them exceptional nest sites; and finally, that *Strumigenys nidifex* has been able to expand its prey range in the absence of effective ponerine and myrmicine competitors on Fiji.

But the consideration whether these independent and secondary modifications are causally connected with polyphagy should not distract from the central question, which is whether the Dacetini were primitively polyphagous or oligophagous. Much depends on the status of *Daceton armigerum*. It can be argued that the polyphagy shown by this species, a member of one of the two most primitive living dacetine genera, is truly the primitive condition for the Dacetini, and that specialization toward collembolan predation is the derived condition. However, the opposite possibility must continue to be borne in mind. Strict collembolan feeding appears to be

characteristic of some other relatively primitive, epigaeic dacetines (*Orectognathus, Epopostruma*) that are widely separated phyletically. Moreover, like so many other primitive taxa, *Daceton* possesses, in addition to its truly primitive features, characters that appear to represent significant specializations away from the main line of dacetine evolution, viz., in sculpturing, worker polymorphism, cephalic articulation, and larval morphology (see Brown, 1953a; and Wheeler and Wheeler, 1954). Perhaps new light will be shed on this problem when the behavior of *Daceton* and the other living dacetite genus, *Acanthognathus*, becomes better known.

EVOLUTIONARY TRENDS: MORPHOLOGICAL CHARACTERS IN THE COADAPTIVE SYSTEM

The evolution of the Dacetini has been marked by a series of major morphological changes. Some of these are clearly coadaptive with the tendency toward cryptic foraging. Others have no known adaptive significance but are so closely associated with the major adaptive shift that they must continue to be examined in this connection.

Decrease in size. This has been a general tendency in most major groups within the tribe. As a result, the smallest dacetine workers are found in the more specialized species of the most highly evolved subtribe, the Dacetiti. A tendency toward small size is a general characteristic of cryptobiotic ant groups.

Shift from long to short mandibles. The primitive dacetine mandible is the long type, consisting of a linear shaft with more or less parallel margins, bearing at its apex two or three large incurved teeth. This kind of mandible is found in all four extant subtribes and is the only one in the Dacetiti and Orectognathiti (Figs. 1–4), in which workers and females have the primitive palpi with 5 maxillary and 3 labial segments; Dacetiti have 11 antennal segments, the primitive (largest) number for the tribe. In Epopostrumiti, the long mandibular type is the only one found in the otherwise generalized genera *Hexadaceton, Epopostruma,* and *Microdaceton,* which all have the palpi segmented 5 and 3, and the antennae 6-segmented. In the Epopostrumiti (Figs. 6–8) and Strumigeniti (Figs. 13–15, 30–33), the mandibles have evolved via different pathways to shorter types with serial dentition along their inner margins. Shortening of the mandibles in several lines in both subtribes is accompanied by reduction of antennal segmentation from 6 to 5 or 4. Presumably, the short mandibles are more advantageous in the cramped spaces hunted by the more cryptic foragers.

Reduction of palpi. This is the rule in the Strumigeniti, all of which have one short segment in each of the maxillary and labial palpi, as compared to the other subtribes, which have the segmentation 5 maxillary, 3 labial. Reduction of palpal segmentation in other ant groups is often correlated with a shift from open to cryptic foraging.

Development of antennal scrobes. The development of a longitudinal groove (scrobe) into which the antennae can be folded is well marked in some of the higher phyletic lines of the Dacetini. Scrobes are a common characteristic of other slow-moving, cryptobiotic myrmicine ants.

Reduction of the compound eyes and their ventral displacement by the antennal scrobes. These two trends are evidence of the declining role of vision in the behavior of the cryptobiotic forms.

Depigmentation. This tendency is clearly associated with cryptobiotic life in some cases, but is also occasionally associated with the secondary development of nocturnal epigaeic foraging, as in some open-country species of *Colobostruma.*

Changes in antennal form and postion: reduction of segmentation, thickening of funiculus, and increasing relative prominence of terminal funicular segment. These changes, closely correlated in the higher Dacetini, are commonly seen in other cryptobiotic ants. Their adaptive significance is not well understood.

Development of bizarre pilosity. The appearance of unusual setae on the body and appendages, shaped variously to resemble threads, spoons, oars, clubs, scales, spheres, etc., is a common feature in the higher Dacetini. In earlier papers (Brown, 1950; Wilson, 1954) we have suggested that these aberrant structures might serve as tactile lures for the prey or tactile "camouflage" in cryptobiotic dacetines, but the hypothesis has not yet been adequately tested.

Modification of sculpturing. There has been a clear-cut trend in the Dacetini as a whole from coarse, foveate sculpturing to relatively fine, dense, punctate sculpturing. In a few cases (e.g. *Arnoldidris* spp., *Gymnomyrmex splendens* Borgmeier) another change has occurred: sculpturing has been lost altogether over large parts of the body. These modifications are clearly related to changes in the pilosity system of the body, which

in turn may be related to changes in the organization of mechanoreception; but the matter has not been subjected to critical examination.

Development of spongiform appendages. In the Strumigeniti most of the species have developed curious symmetrical sponge-like masses on the petiole and postpetiole. Sometimes these masses are extended to the alitrunk and gaster. They are composed of integumentary outgrowths, much folded and areolated, and are sometimes associated with glandular areas. Their function is unknown. The strumigenite species that lack well-developed structures of this sort appear to have lost them secondarily. Their evolutionary origin is suggested by the morphocline produced in an independent phyletic line within the Epopostrumiti. Here are seen lateral spines transformed through a series of evolutionary steps into structures approaching in form the strumigenite spongiform appendages. (See Figs. 9–12).

Reduction of spination. This trend is shown within all phyletic lines, except the derivative Strumigeniti, the modern species of which nearly all already have the minimum fixed armament. Reduced spination is a common trait of other cryptobiotic ant groups as well as, curiously, some groups that are high-arboreal and stem-dwelling (Wilson, 1959).

DIFFERENTIAL RATES IN "MAINSTREAM" AND "COUNTERCURRENT" EVOLUTION

The ethological and morphological characters described in the preceding sections show closely associated trends in their respective evolutionary histories in the principal phyletic lines of the Dacetini. Only a few examples can be cited of conspicuously differential rates in the evolution of independent characters. In the Epopostrumiti, to take a case in point, a shift from long to short mandibles is not accompanied by a significant reduction in worker eye size.

On the other hand, differential rates appear to be the rule during the short-range reversals in evolution ("countercurrent" evolution) that occur commonly in the Dacetini. Countercurrent evolution in this group has some features that deserve special attention. First, it is perhaps not too commonplace to note that the changes that occur do not represent precise reversals, in a strictly genetic sense, of the primary trends. It is noteworthy that the primary trends can be characterized generally as a movement toward specialization. The forsaking of the epigaeic foraging areas and an increased tendency toward cryptobiotic life is a derived condition for ants generally. Cryptic foraging undoubtedly opens up food and shelter niches to the higher dacetines that are but little exploited by the epigaeic forms. But it also constitutes a retreat from major niches that remain in full use (or are taken over?) by other dominant ant groups. Cryptobiotic life has been attended by some unusual evolutionary additive innovations, such as bizarre pilosity and the spongiform appendages, but in other ways it is regressive (reductive), especially where such fundamental structures as the antennae, palps, and eyes are involved. Finally, the oligophagous collembolan predation shown by many higher dacetines must be considered a specialization in the strict sense, whether it was first acquired by post-dacetite lines or by the line ancestral to all Dacetini.

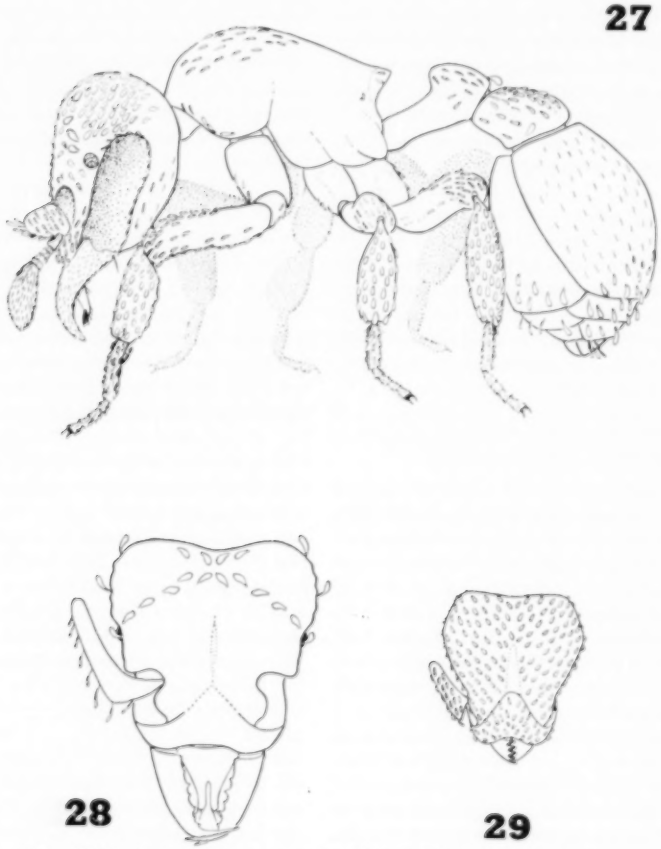
Countercurrent evolution, in the cases inferred, represents for the most part a breaking-out from the narrowing adaptive zone into which higher dacetines appear to have moved. The secondary changes involved include the following: increase in size, increase in relative eye size, lengthening of the mandibles and reduction of tooth number, increase in latitude of food habits, loss of spongiform appendages, increased pigmentation (melanization) and reduction of pilosity. To cite an example, *Strumigenys nidifex*, a Fijian member of the *S. australis* group, has undergone an increase in size and pigmentation and a broadening of food habits. Not all divergent trends can be considered as reversals of the primary dacetine trends. The loss of sculpturing in several groups, for instance, can be considered neither an extension of primary evolution nor a reversal of it, but rather a special trend in itself. The acquisition of worker polymorphism may fall in the same category.

Wherever countercurrent evolution has occurred, usually only a small number of characters has been involved, while others belonging to the postulated "coadaptive system" have remained relatively unchanged. For instance, in the case of *Strumigenys nidifex* just cited, size and pigmentation have been increased and food habits broadened without marked changes in other characters. The workers of certain Neotropical members of the short-mandibulate, cryptobiotic genus *Smithistruma* have taken to arboreal life in epiphyte masses, and their eyes

have been enlarged and spongiform appendages reduced; but in other characters they have remained typical for the genus. Parallel changes have occurred in some species of *Strumigenys* and *Colobostruma* (Fig. 8). A striking secondary lengthening of the mandibles and labrum has occurred in one species of *Neostruma* (Fig. 16), in *Epitritus* (Fig. 24) and in *Dorisidris nitens* (Santschi) without significant reversals in other morphological characters. In the parasitic species *Kyidris yaleogyna* Wilson and Brown, the females have lost most of their sculpturing, and the workers have undergone various degenerative changes in behavior without radical modification of most of their typical "dacetine" morphological characters.

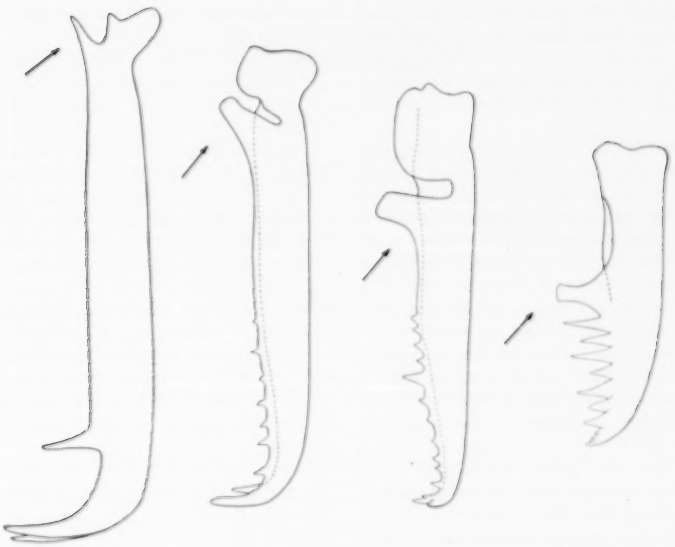
CONVERGENCE TO THE DACETINE TYPE BY OTHER ANT GROUPS

Several other phyletic lines within the subfamily Myrmicinae show notable convergence to certain of the higher Dacetini. This resemblance is so astonishingly detailed that frequently they and their relatives have been placed by ex-



FIGS. 27–29. SOME SPECIES OF THE ANT TRIBE BASICEROTINI THAT ARE CONVERGENT TO HIGHER DACETINES

Fig. 27 *Rhopalothrix biroi*, worker, side view. A short-mandibulate form. Fig. 28. *Rhopalothrix ciliata*, worker, dorsal view of head and mandibles, antennae omitted except for right scape (compare with *Epitritus*, Fig. 24). Fig. 29. *Rhopalothrix bruchi*, same. In the Basicerotini, relatively short triangular mandibles are the basic primitive type, and elongate ones like those of *R. ciliata* are derived, which is the reverse of the situation in the Dacetini.



FIGS. 30–33. PROBABLE MODE OF EVOLUTION OF THE SHORT TYPE OF MANDIBLE IN THE SUBTRIBE STRUMIGENITI

Starting with the basic *Strumigenys* type of mandible, Fig. 30, successive modifications may have led through the *S. gundlachi* group type, Fig. 31 and the *Neostruma* type, Fig. 32; to the *Smithistruma* type, Fig. 33. However, *Smithistruma* almost certainly arose from another stock of *Strumigenys*, and not via the *Neostruma* line. Note the changes in position and form of the basal tooth or lamella (arrows).

perienced systematists within the tribe Dacetini. Convergent groups include the genera *Calyptomyrmex*, *Dacetinops*, and *Rhopalothrix* (Figs. 27–29). The dacetine-like morphological characters, some or all of which are found in each of these genera, include reduction and apicalization of the antennal funiculus, reduction of palps, narrowing of the anterior portion of the head, prognathism, development of antennal scrobes, modification of sculpturing to dense puncturation, development of bizarre pilosity (especially clavate and squamate hairs), reduction of compound eyes, depigmentation, development of pedicellar spongiform appendages, and development of prominent ribbing at the base of the gaster. These characters appear to have been derived entirely independently in each group. Further, in the case of the tribe Basicerotini the known primitive members (*Basiceros*, *Aspididris*) are much less like higher dacetines than is the derivative genus *Rhopalothrix* (Brown and Kempf, 1960).

The behavior of only one of the convergent forms has been studied. Workers of the Papuasian *Rhopalothrix biroi* Emery have proven to be remarkably similar to some of the short-mandibulate dacetines in their stalking behavior, and they appear to prey in large part on entomobryomorph collembolans (Wilson, 1957).

ACKNOWLEDGMENTS

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NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.*

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GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

BIOLOGY *and its Relation to Mankind. Second Edition.*

By A. M. Winchester and B. J. Kaston. D. Van Nostrand, Toronto, New York, and London. $7.25. x + 902 pp.; ill. 1957.

The second edition of this elementary college biology textbook retains the general organization of the first edition, as well as its primary emphasis upon human aspects and relationships of biology. The first eight chapters provide an introduction to the nature of living organization and processes: cellular structure and division, the chemistry of living matter, and energy relationships in metabolism. There follows a survey of the plant kingdom and a consideration of plant structure and physiology, after which a survey of the animal kingdom, from protozoa through chordates, comes naturally. The organization and physiology of man as a typical vertebrate then leads into the story of embryonic development, heredity, and reproduction. Ecology, evolution, and a final "tacked-on" chapter on the history of biology conclude the treatment.

The style of the text is kept to simple, clear exposition, with a minimum of technical terms; and the treatment of topics is at an elementary level suitable for the general student who does not intend to specialize in the biological sciences. The work is excellently illustrated, many of the photographs used being originals taken by Winchester himself. Unfortunately, the paper used is not of a quality sufficient to bring out these pictures properly, and many of the halftones are blurred or dim in consequence.

BENTLEY GLASS

MAN AND TIME. *Papers from the Eranos Yearbooks 3. Bollingen Series XXX.*

Translated by Ralph Manheim and R. F. C. Hull. Pantheon Books, New York. $5.00. xx + 414 pp. + 4 pl. 1957.

One of the tenets of Benedetto Croce's variation on Hegelian idealism is that philosophy is coincidental with the history of ideas. Although from the point of view of many of the more traditional Western philosophies this may be a questionable dictum, it seems more and more apparent that the study of the history of ideas is one of the most fruitful pursuits now engaged in by Western philosophy.

Indeed, viewed from a later age, it may appear that the great twentieth century contributions to philosophy have been chiefly in the study of the history of ideas.

The anomalous aspect of the current emphasis on the history of ideas, however, is that this is not an area of study in any way peculiar to the professional philosophers. On the contrary, it is a field dominated by scholars in other disciplines. Hence one should not really be surprised to find that this collection of essays is the product of scholars in such diverse fields as Islamic studies, comparative religion, theology, psychology, medicine, patrology, sociology, sinology, zoology, and electrical engineering. These essays, all but one drawn from issues of the *Eranos-Jahrbücher*, comprise papers delivered at the Eranos meetings held every summer near Ascona, Switzerland. Although certain of the papers in this collection are no more than expositions of various Jungian themes, particularly the theory of archetypes, the bulk of these essays are, albeit with occasional Jungian trappings, intensely scholarly studies in the history of the idea of time.

The essay in this collection of most immediate interest to the scientist, Max Knoll's Transformations of Science in Our Age, is perhaps more speculative and more Jungian than historical or scholarly. Knoll believes that he has discovered the basis for a new synthesis of human knowledge—a synthesis which he believes is now in process of realization: "In the sciences, the tendency to seek a logically or causally homogeneous description of nature and things (designed after the pattern of mathematics) is on the decline. It is giving way to a trend, originating in philosophy, psychology, and atomic physics, to stress the bipolar character of the phenomenal world and of time" (p. 307). This transformation, Knoll believes, is of an "archetypal character."

The bipolarity which Knoll describes is not, however, philosophically akin to the Aristotelian bipolarities of essence and existence or matter and form, but rather to the Cartesian mind-body dualism, as is revealed in Knoll's distinction between "intuitive perception" and "observational perception" (p. 271). Thus it is interesting to observe an attempt, on psychological grounds, to discard Cartesian mathematicism and keep what has sometimes been called "Cartesian mentalism;" but it is even more interesting to observe that the author relates not only his Cartesianism, but also the Jungian theory of archetypes, to a Platonic ancestry: "The existence of 'rational' and of 'observing' perception (cognition) in physics is evident. What is not so universally recognized (though often postulated) is the existence of a special 'intuitive' function, a 'faculty of inner vision,' which one might designate more accurately as a non-sensory perception of the pre-existent 'ideas' in the Platonic sense, or of inherited archetypes in the Jungian sense, or of a previously unconscious content" (p. 270).

So it is that what purports to be an investigation of the patterns of ideas in scientific theory and in natural phenomena emerges as a defense of a twentieth century psychological Platonism, and becomes itself another document in the history of ideas.

JAMES J. HILL

THE SIMPLICITY OF SCIENCE.
By Stanley D. Beck. Doubleday & Company, Garden City. $3.75. 212 pp.; ill. 1959.

The intended audience for this book quite apparently is the not very well-informed non-scientist. Explanations and examples are simplicity itself; and the writing is smooth, clear, and direct (the June, 1959 *American Scientist* printed excerpts from this book in its new section devoted to outstanding literary efforts of scientists). To a great extent Stanley D. Beck (not to be confused with William S. Beck, who also writes about the nature and philosophy of science for the layman—*Modern Science and the Nature of Life*, 1957) does admirably in explaining what science is and what a scientist does. The intended reader is not likely to be disturbed by what he reads here; and many will be pleased to learn how little controversy there is in general and how little science bears on questions of interest to him. For example, the reader will infer (p. 77) that scientists (at least one scientist) regard mechanism and vitalism as equally valid, equally popular, untestable theories which explain the same observations. Throughout the book the limitations and assumptions of science are emphasized in a manner bound to nourish the view that theology, philosophy, and science are equally valid and valuable ways of interpreting the same experiences and are rarely at odds.

As the statement stands, without further comment, on p. 167, who would doubt that "the relationship of a mother to a baby is hardly to be expressed fully in the terms of either measurements or a simple sequence of events?" But one would think, considering to whom the book is addressed and knowing that Beck is himself a student of animal behavior, that he would rather make the more daring point that already there have been surprisingly fruitful attempts to analyze this most complex relationship. Would it not be more interesting and more informative to tell the reader about the action of prolactin and its effect on maternal behavior, the studies of mother-substitutes for infant monkeys, or about imprinting of ducklings? Regrettably, the viewpoint expressed in this book is not the one that suffers from a lack of publicity.

DAVID R. EVANS

BIOLOGY: HISTORY AND BIOGRAPHY

THE ADMIRABLE DISCOURSES OF BERNARD PALISSY. *Translated by Aurèle La Roque. The University of Illinois Press, Urbana.* $5.50. xii + 264 pp. 1957.

When a work so highly praised and so seldom read as the *Admirable Discourses* of Bernard Palissy is finally rescued from the obscurity imposed by its rarity and its Renaissance language and is made available in a scholarly translation and an attractive but reasonably priced format, everyone interested in the history of the sciences has reason for some excitement. The *Discourses*, one of the two major works of the famous 16th century ceramist and self-taught scientist, grew out of a series of lectures given in Paris in 1575. Palissy's topics are of primary interest to geologists, chemists, crystallographers, and soil scientists; but his insight into the formation of fossils makes him of great significance to biologists, too.

Palissy was fascinated by the shells and the fishes in the rocks. He was not the first to recognize their true nature—there was Xenophanes in the fifth century B.C.; and shortly before Palissy's own day, Leonardo da Vinci and Jerome Cardan had correctly appraised them as the relics of bygone life—no lusus naturae. But Palissy reacted vigorously against Cardan's suggestion that the presence of shellfish fossils in the rocks could be attributed to the Flood, sweeping them inland from their homes in the sea. They must have been buried where they had lived, he argued; and that conclusion implied the existence of bodies of water, such as large lakes, in the mud of which the shellfish could have become imbedded and by salinification preserved. He thought of these bodies as freshwater lakes, but nevertheless having some salinity, sufficient to permit precipitation of salts and petrifaction of the shells. Shrewdly he pointed to the difference between shells simply buried in sands and those which, being buried in mud that changed to stone, became altered in constitution like the matrix itself.

No one before his time had as good a conception as did Palissy of the vast variety of fossil species. After collecting them for years, and marvelling at their abundance in certain situations and noting that some of them differed from any species currently found in the North Atlantic—though some of them resembled mollusks he had received from the Indian or South Atlantic Oceans—Palissy states that "finally I have found more kinds of fishes or their shells, petrified in the earth, than of modern kinds that live in the Ocean sea. And although I have found petrified shells of oysters, cockles, hardshell clams . . . mussels, razor-clams, scallops, sea chestnuts, crayfish, snails and all kinds of other snails that live in the Ocean sea, still I have found some in many places . . . some kinds whose like is unknown to us, and none are to be found unless they are lapified." He was especially impressed by the few rare specimens in which the soft body parts as well as the hard shells had been petrified.

Over a hundred years ago, Henry Morley wrote two biographies, the one of Jerome Cardan, the other of Bernard Palissy. In a pungent guide for the reading of young biologists, entitled *To Begin With*, the founder and first editor of the *Quarterly Review of Biology* highly recommended those books, as giving insight into the scientific thinking of two great men who lived at the very dawn of the modern scientific era. Raymond Pearl would have been truly delighted to see this book.

BENTLEY GLASS

WILLIAM HARVEY'S DE MOTU LOCALI ANIMALIUM, 1627. *Edited, translated, and introduced by Gweneth Whitteridge. Cambridge University Press, New York and London.* $10.50. xii + 163 pp. + 1 pl. 1959.

This book, issued in honor of the tercentenary of Harvey's death, is the previously unpublished British Museum manuscript Sloane 486, ff 69–118 v which is in Harvey's handwriting. To this text, the majority of which is in Latin, G. Whitteridge has added an English translation and many notes. Harvey's manuscript is far from being in final literary form; it appears to be only the rough draft for a much larger work.

Harvey bases much of his argument on Aristotle's works, in particular *De incessu animalium*. The editor has done much to make the Latin text readable, as a glance at the portion of the original manuscript reproduced in this book shows, and has further added to this by her rather free English translation. Nevertheless, this is no major work of science, even though it furnishes a good insight into Harvey's views of science and anatomy. He was strongly influenced by Aristotle's analysis of life, but nonetheless insists that we must learn anatomy by dissection and experiment. Of historical importance, this book is certainly a worthy addition to the meager store of works by the immortal Harvey.

MYRON L. WOLBARSHT

FORERUNNERS OF DARWIN: 1745–1859. *Edited by Bentley Glass, Owsei Temkin, and William L. Straus, Jr.; under the auspices of the Johns Hopkins History of Ideas Club. The Johns Hopkins Press, Baltimore.* $6.50. viii + 471 pp. + 6 pl. 1959.

The centennial of the *Origin of Species* has been the occasion for a surfeit of collaborative works in which

groups of experts have reviewed Darwin's achievements in the light of present day knowledge. This book is something different; and it will probably prove of more lasting value than many of the symposia. It is, as the editors point out, "in no way intended to detract from his (Darwin's) proper glory, but rather to provide a setting whereby to judge it aright." It contains 15 essays, which were originally presented to the History of Ideas Club at The Johns Hopkins University. They describe the views on the constancy or evolutionary nature of species which were held by various authors in the eighteenth and early nineteenth centuries. Six of the essays are by that doyen of the history of the theory of evolution, Arthur O. Lovejoy, and another three by Bentley Glass. They are all delightfully written, and, at least to the non-specialist such as this reviewer, make an impression of broad, urbane, and reliable scholarship. Most biologists, unless they have studied the matter in some detail before, are likely to be surprised by the richness and variety of the theories which were held, and the closeness with which some of these thinkers approached the modern point of view. A striking example of this is Maupertuis, whom Bentley Glass shows, in a fascinating essay, to have grasped many of the most important points in the discoveries not only of Darwin but of Mendel. If he had not, as Nancy Mitford has recently reminded us, (*Voltaire in Love*), committed the tactical error of lifemanship of playing around with the girl-friend of an inspired journalist, he would today be generally honored as one of the founders of modern biology.

This is emphatically a book to possess and to dip into from time to time over a period of months or even of years.

C. H. Waddington

A Hundred Years of Evolution.

By G. S. Carter. The Macmillan Company, New York. $3.75. x + 206 pp.; ill. 1957.

The centenary of the publication of the *Origin of Species* has led to the preparation of a considerable number of symposia and individual books undertaken to reevaluate, after the passage of one hundred years, the theory of evolution and the role of natural selection in evolutionary processes. Carter's volume was one of the first to appear. It is clearly a competent, straightforward contribution that will be valuable to the general biological reader for just the purpose intended. At the same time, one cannot say that it is strikingly original in content or point of view. In one respect, it suffers from having been among the first such volumes, since that has prevented it from profiting by some of the new light thrown on the genesis of Darwin's own thought in recent publications, particularly the essay of Loren Eiseley on the development of the theory of natural selection by Edward Blyth. In creating the forerunners of Darwin, Carter has presented the conventional picture—Erasmus Darwin, Lamarck, Malthus, and Lyell being the principal figures mentioned. There is an interesting and valuable chapter on the reaction to "The Origin" among the general public, and this is followed by one on the reactions of Darwin's fellow biologists to the new theory. The first part of the book concludes with a consideration of the additions to evolutionary thinking during the later 19th century.

Part II of the book is devoted to the 20th century, and represents a concise and well-balanced account of the rise of genetics (3 chapters), the relation of developments in ecology during the last 30 years to evolutionary theory, and micro- and macro-evolution. The point of view taken by the author is that generally adopted by neo-Darwinians, as summarized in the works of Dobzhansky, Simpson, Mayr, Julian Huxley, Rensch, and others. There is relatively little consideration of plant evolution in the book, a deficiency no doubt to be expected from a zoologist. Also no attempt has been made to marshal the existing evidence in regard to historical evolution, but rather to afford insight into the working of the evolutionary processes at different levels. Although the author does creditably in this respect, it must be admitted that the book lacks the zest and stimulation of Simpson's comparable volume, *The Meaning of Evolution* (1950). Simpson's book, on the other hand, is dedicated solely to an exposition of the modern views on evolution and lacks any account of the historical development of evolutionary theory. *A Hundred Years of Evolution* thus constitutes a valuable addition to the centennial shelf.

Bentley Glass

Gregor Mendel *und das Schicksal seiner Vererbungsgesetze.*

By Ingo Krumbiegel. Wissenschaftliche Verlagsgesellschaft M.B.H., Stuttgart. DM 10.80. 144 pp.; ill. 1957.

This little book forms the twenty-second of a series of short biographies of great men of biology. Although in the description of Mendel's life the author closely follows the account given by Hugo Iltis, this volume is not a mere condensation of the latter but includes some reinterpretations of the story of Mendel's work.

In the introductory chapter Krumbiegel chooses Leeuwenhoek (1632) as one of the greatest forerunners of modern genetic thought. Not many geneticists know that Leeuwenhoek noticed that in Belgian rabbits a single gray sire crossed en masse with dams of various colors would always produce some gray offspring which also lacked the long ears and tameness of the solid-colored or white mothers.

Krumbiegel points out that this first attempt to observe the inheritance of separate characteristics, if continued, might have made Leeuwenhoek more famous than his microscopical studies. But Leeuwenhoek did not make paired matings and was concerned with the erroneous question of the importance of maternal vs. paternal inheritance.

The remainder of the first chapter is devoted to a brief review of fundamental genetic principles. The author discusses Mendel's Laws of Segregation and Random Assortment and the cytological bases underlying these principles. There follows a brief account of the problem of dominance and its variation, of sex determination and sex chromosomes, genes, mutation, and chromosome maps. Obviously such a survey must be brief, given mainly to show the lack of knowledge with which Mendel and his predecessors had to work. It is surprising to find here the statement that heteromorphic sex chromosomes have been found only in lower plants (p. 19) when actually these have for many years been figured in over fifty species of angiosperms. Frogs are said to possess male heterogamety (p. 19), whereas the work of several authors in the nineteen-thirties has shown the claim by an earlier author of distinct X and Y chromosomes in frogs to be incorrect. The author's statement that "as to how the sex chromosomes work we can until now only express conjectures" (p. 20) would seem to have been written prior to the past two decades. Although space for discussion is necessarily limited in so short a volume, both students and workers outside the field of genetics will receive an erroneous impression upon reading that we *still* lack an explanation of how either spontaneous mutation or mutation under the influence of x-radiation takes place (p. 22). Nor, in the light of the essentially random nature of mutation in experimental work, can one agree with the author's statement that "we know now . . . the tendency of a species to mutate in a definite direction in numerous individuals" (p. 23).

In the second chapter the author shows that genetic experiments in plants became possible following the establishment of sexuality in plants by John Ray (1693) and Camerarius (1694). Kölreuter (1733), the great premendelist, is said to have made the first crosses with plants, but failed to record exact numbers of the progeny. A significant predecessor of Mendel was Seton, who in 1824 crossed green and white peas and recovered segregants in the F_2. Krumbiegel likewise mentions Naudin's work immediately preceding that of Mendel. Naudin recognized the uniformity of the hybrid and the purity of gametes of hybrids (essentially Mendel's First Law). The author points out that both Naudin and Gärtner (whose works were known to Mendel) did not count and classify a sufficient number of progeny of their crosses. Here also might have been mentioned Vilmorin (1856), whose methods of observing the offspring of each individual plant were closely similar to Mendel's, although neither worker knew of the other.

In the third chapter Krumbiegel considers Mendel's personality, life, and botanical work. The story of Mendel's forebears, his early life as the son of hard-working farming parents, aptitude at school, and entrance into the Augustinian monastery closely follows Iltis's biography. Krumbiegel considers fortunate Mendel's coming into the monastery, since his education was thereby furthered. The author takes exception to Iltis' suggestion that Mendel may have suppressed his genetical studies of mice in order not to offend the church authorities. There was, he thinks, complete freedom of endeavor at that time within the monastery. The author believes that Mendel chose peas as his major object of research partly because of his childhood love of plant work with his father and also because of his deep interest in Darwin's work, which led him to think that there was still something to be discovered in the plant hybridization problem. Mendel's botanical work is known to us chiefly through his own famous paper on peas, his paper on *Hieracium* hybrids, and his letters to the well-known Professor Carl von Nägeli, found and published by Correns, a former student of Nägeli and a rediscoverer of Mendel's laws. Unfortunately, only fragments of Nägeli's letters in reply to Mendel have survived. Krumbiegel quotes a portion of Nägeli's reply to Mendel's first letter. This correspondence shows the chief cause of the failure of Mendel's discovery to be communicated to the scientific world for the next forty years. As the author points out, Nägeli rejected Mendel's deductions on philosophical grounds, questioned the general applicability of the pea results, and clearly disbelieved that homozygotes could be extracted from hybrids. The last objection is corroborated by Nägeli's marginal note on Mendel's paper, according to Correns. Krumbiegel and Iltis, following Correns, have concluded that the initial failure of Mendel's work to be appreciated by biologists came from the failure of his contact with Nägeli. Weinstein has recently challenged the view that Nägeli did not understand Mendel's work. If not, Nägeli certainly refused to accept it. Krumbiegel attributes Nägeli's negative reaction to his own engrossment in a number of other problems of biology. The author stresses Nägeli's influence over Mendel with respect to the *Hieracium* hybridization experiments. Mendel's inability to duplicate his pea results in *Hieracium*, owing to apogamy in the latter, led him, according to Krumbiegel, to doubt the general applicability of his earlier findings. This self-doubt, the author believes, was a major cause for Mendel's discoveries lying unnoticed, for the major responsibility for spreading ideas lies with the originator

of them. On the other hand, Mendel, in discussing the problem of general applicability in his original paper, gives the verification of his laws in *Phaseolus*. He also mentions several cases of constant hybrids studied by Gärtner and Wichura. In his *Hieracium* paper Mendel concluded that the behavior of *Hieracium* is similar to the latter. Hence I am not convinced that a failure to find a similarity in peas and *Hieracium* discouraged Mendel as to the general applicability of his laws of heredity. He may have regarded these "constant hybrids" as the special cases which they do indeed represent.

Two factors other than the lack of agreement between the pea and *Hieracium* experiments may have had an important influence in keeping Mendel from pressing his well-substantiated conclusions. First, in his letter of December 31, 1866 to Nägeli, Mendel mentions the necessity of giving up the pea experiments because of the devastation caused by the pea beetle, *Bruchus pisi*. Were it not for this misfortune, Mendel would certainly have continued publication on peas, corroborating and extending his observations, and referring to his original paper. As the Natural History Society of Brünn is known to have exchanged reprints with foreign societies, there would then have been a greater chance of recognition of his work. Secondly, studies of plant hybridization at the time Mendel was working became associated with Darwin's ideas on the origin of species. After the publication of *The Descent of Man* in 1871, there was a conflict between science and the Church. Although Mendel was most interested in Darwin's theories, the latter never knew of Mendel. It is an ironic thought that Haeckel, by his aggressive championship of Darwin against religion in Germany, may have created a situation which prevented Mendel, out of loyalty to the Church, from trying to make further contacts with biologists in his field.

Krumbiegel emphasizes the fact that added duties after Mendel became a prelate, as well as his struggle over the cloister tax, hampered Mendel's experimental work. Mendel himself, in a letter to Nägeli, complained that his duties kept him from his experiments. According to this biography, the disappointments of Mendel's later years, together with his chronic kidney ailment, led to a general nervous breakdown, but Iltis is in disagreement with this view. A final chapter covers the fascinating story of the rediscovery of Mendel's work in 1900.

This stimulating little volume should prove of interest not only to those who feel that a historical development of a subject is of great service in teaching genetics, but also to people interested in the history of biological thought for its own sake. Although no index is supplied, a special list of men who were living during Mendel's time and are mentioned in the text, with a thumb-nail sketch of each, is presented as an addendum. A second similar list is given of men not living in Mendel's time but referred to in the text. Here unfortunately the author makes a serious mistake in the material descriptive of Richard Goldschmidt. Goldschmidt became Director of the Kaiser-Wilhelm-Institut für Biologie at Dahlem in 1921, not in 1929, as stated. Upon the passage of the "Nürnberg Laws," Goldschmidt accepted an invitation in 1936 to join the Zoology Department of the University of California, Berkeley, where, as American geneticists know, he remained until his death in April, 1958. Instead, the author states that after his post in Germany, Goldschmidt went to the University of Jerusalem. Richard Goldschmidt was never on the faculty of The Hebrew University in Jerusalem; possibly the author may have confused him with Elisabeth Goldschmidt, a geneticist on the faculty of that institution.

SARAH B. PIPKIN

A HISTORY OF NEUROLOGY. *MD Monographs on Medical History, Number Two.*

By Walther Riese; foreword by Félix Martí-Ibáñez. MD Publications, New York. $4.00. 223 pp.; ill. 1959.

Riese has examined in some detail the philosophical foundations of neurology. Although neurology is one of the youngest of the medical specialties, some of its concepts were formulated by Hippocrates. The author has chosen to discuss the problems of neurology rather than the discoveries. However, many problems can only be understood in terms of some particular series of experiments. Although there is a chapter on the history of the nervous impulse, there is no mention of the work of any of the following: von Helmholtz, Bernstein, Erlanger, Gasser, Hodgkin, Huxley, or Nachmansohn. Adrian is cited only in connection with his work on the electroencephalogram. Nowhere in the long chapter on cerebral localization is Victor Horsley's work discussed, and the history of the reflex action does not include Sechenov—or even Pavlov. Babinski's attempts to separate neurology from psychiatry are ignored, and Cajal's contributions to the understanding of the fine structure of the nervous system are relegated to a chronological appendix.

These omissions may be excusable, but crediting Hans Berger with the discovery of the brain waves is not. Berger himself refers to Caton's work of 50 years earlier. This book may be a history but it is certainly not one of neurology.

MYRON L. WOLBARSHT

ONE MAN'S LIFE WITH BARLEY. *The Memories and Observations of Harry V. Harlan.*

By Harry V. Harlan; foreword by Jack R. Harlan;

introduction by Mary Martini. Exposition Press, New York. $6.00. xviii + 223 pp. + 33 pl. 1957.

Harry V. Harlan, who died in 1944, was one of the great American plant explorers and introducers who made the Bureau of Plant Industry justly renowned. His specialty was barley, which he hunted in Africa and Asia, Peru and Europe. These memoirs, edited by his son, make engrossing reading, as much for the revelation of a homespun personality as for the story of barley it unfolds. Harlan lacked the breadth of biological knowledge of such a man as Vavilov, and his ideas of effective plant breeding seem to have been confined to a search for wild types with useful characters, then hybridization, and selection among the segregants followed by inbreeding. He seems to have been ignorant of L. J. Stadler's pioneer studies in the induction of mutations by x-raying barley, and he scoffed at the idea that mutations or chromosome aberrations would ever have the slightest practical consequences. He would have been undoubtedly dismayed and staggered by the increased yields characteristic of some of the mutants induced by Gustafsson, Kuckuck, and others. He would have been, on the other hand, delighted at the discovery of wild, 2-row barley in the Mesopotamian excavations of Jarmo, dated by carbon-14 at 7000 B.C., and showing just those slight changes in the direction of increased seed size and toughness of spike that reveal that domestication had begun—for this would have been in line with his own earlier conjectures about the origin of our cultivated 6-row barleys.

Highly amusing is his salty chapter of Advice to the young scientist. The section on how to take criticism, especially from one's boss or editor, is well worth reading.

BENTLEY GLASS

THE YOUNG NATURALIST

BIOLOGY. *A Basic Science.*

By Elwood D. Heiss and Richard H. Lape. D. Van Nostrand Company, Toronto, Princeton, London, and New York. $4.88. xii + 648 pp. + 1 folded chart; ill. 1958.

BIOLOGY *Serving You.*

By Charles Gramet and James Mendel. Prentice-Hall, Englewood Cliffs. $4.96. viii + 616 pp.; ill. 1958.

BIOLOGY FOR YOU. *Fourth Edition.*

By B. B. Vance and D. F. Miller. J. B. Lippincott Company, Chicago, Philadelphia, and New York. $4.80. x + 654 pp.; ill. 1958.

BIOLOGY *and Human Progress. Second Edition.*

By Louis Eisman and Charles Tanzer. Prentice-Hall, Englewood Cliffs. $4.80. xvi + 544 pp.; ill. 1958.

Teacher's Manual and Key to accompany BIOLOGY *and Human Progress. Second Edition.*

By Louis Eisman and Charles Tanzer. Prentice-Hall, Englewood Cliffs. $1.75. vi + 117 pp. 1958.

What should be taught in General Biology in the high school? Opinions will certainly differ, but the following suggestions represent certain strong present trends which may serve as a standard against which the textbooks reviewed here may be measured.

Science should be presented as more than a body of facts. It is a body of relatively dependable information (which we call "fact") that man has abstracted from nature. It is necessary to project an appreciation for this process of abstraction which we call "science," for the imagined "model" and the measurement of its dimensions. The "facts" of science should never be offered with an air of finality. Complete certainty may exist in the mind that believes in magic, but it does not exist in science. In addition to presenting what we feel we "know" in science, we must acquaint the student with those areas in which great questions exist and give him the confidence to approach these questions and feel their challenge. The successes and failures of the men in the history of science can give perspective on the tentative nature of knowledge in our own period. The text or teacher that closes the subject in the student's mind at the end of the chapter is ignorant of the continuous development of science behind its facts.

Certain aspects of biology, certain basic concepts, are fundamental to a good, modern presentation. They should, however, be presented in such a way as to reveal the open questions that exist within them.

1. The physical nature of matter, atomic and molecular theory. Here lies the problem of distinguishing between living and non-living forms of organization and their operation.

2. Levels of organization, beginning with the structural relationships of the cell, the chromosome and on through the multicellular individual as a composite of organ systems. The problem of "biological engineering" of the construction of the organism in the face of the efficiency demands of limited energy supplies now confronts us. The adaptive structures of organisms once gave the thrill of purpose to man. Now they challenge us to understand their origins and their operations.

3. The operations of the systems, the sources of supply and the transfer of energy in living things. The demand here is to explain life functions in terms of physical and chemical forces and to understand their living relationships.

4. The feedback systems of life, the sensitivities of living systems, their capacity to respond to

changes in their internal and external environments, to be in constant flux and yet maintain consistency in operations. This can be considered at the level of the cell, through the multicellular individual into the species level. The concept can be carried into the population equilibria of biomes.

5. The growth and development of living things, both at the level of the cell and in the multicellular individual. What forces and influences shape the growth of the embryo? What are the intermediate mechanisms that so consistently insure that body form is within the "norm of reaction" of a species?

6. Heredity of organisms, asexual and sexual, the continuity of species types and the concept of the gene pool. Here we must consider the origins of species and the diversity of life to appreciate that it is in flux. Life has come from pre-existing life and has distributed itself and has become adapted to almost all places on the earth. Such considerations give us perspective on our own smallness in biologic time.

7. Last, because it demands an understanding of all previous areas, I place the interrelatedness of organisms. Here we should consider symbiosis, commensalism, parasitism, predation, living communities, food chains, and the biomass capacities of land, water, and air environments. These are the considerations that point to the limits on the successes of the individual, group, society, and civilization.

It is imperative to recognize man's place as a creature in nature; not the arrogant knight who brings nature to her knees and imposes a will of conquest, but a highly intelligent, sensitive creature with a capacity to see himself and his niche more clearly than any other animal. Man seems to be the only creature with a capacity to manage his future consciously, and it is upon his understanding of the limits of nature that his own future and that of most of the other life on the planet depends.

We may now proceed to examine some of the merits and defects of the high-school biology textbooks before us in the light of these ideas. The authors have attempted to reduce technical vocabulary and have been confronted with the fact that as you generalize language, precision in communication decreases. Heiss and Lape can be commended for going beyond a consideration of "scientific method" and for attempting to show that science is an attitude, a point of view as well as a method. All the writers could well have expanded the historical development of biological concepts, however. The student needs to know that science advances by persistent intellectual growth which prepares a mind for the moment in which a broad synthesis may occur, leading to a new concept. The simplified scientific method that is cited for the beginning student is not shared by the men who work at the frontier in science. These men know no simple method, but they do share a similar philosophic view of nature.

It is more the fault of biology curricula than of the authors that these texts devote so much space to applied biology. Surely the theory of general biology should be paramount in consideration. The applications of biology acquire greatest meaning for the student after he becomes acquainted with the fundamental areas of biology. Heiss and Lape even enter the controversy over smoking and cancer. They say: "These claims are based on certain statistical studies. However, at the time this book was written, there was no positive proof that smoking causes these diseases." In so stating their case they offer views on the nature of scientific proof that are simply not tenable.

Gramet and Mandel should review their analysis of the differences between plants and animals and their use of the word "vitality." It is preferable not to relate knowledge of the atom to the dropping of the Bomb in 1945 but rather to the more positive aspects of the development of thought in physics. They should also modify their apparent endorsement of the use of DDT in dairy barns, a use which is dangerous to human health.

Heiss and Lape should try to demonstrate what Linnaeus was trying to accomplish with his system of classification. He didn't just "invent" it, but had definite philosophic goals. Their recommendation that for the student's attainment of happiness, "you must adjust yourself well with the environment of things and of people about you," leaves one in doubt, since they do not point out that some of the major advances of mankind have resulted from the fact that certain people refused to heed such advice.

Eisman and Tanzer lead the others in stressing competition as the determining force in evolution. This concept needs reconsideration. The emphasis we give to the various aspects of competition can make a great difference to the future of man. The sociology of Herbert Spencer exemplifies the problem.

Vance and Miller could with benefit expand their concept of mutation. An expanded historical treatment of the work of great men of the past would also prevent the student from going away with the feeling that science is a simple trick.

These books are all worthy efforts to present the fields of General Biology and can stand on their own merits. It is satisfying to see textbooks that are such an improvement over the one I had to use in high school biology teaching.

DAVID G. BARRY

LIVING CHEMISTRY. *Second Revised Edition.* *By Maurice R. Ahrens, Norris F. Bush, and Ray K. Easley. Ginn & Company, Boston, New York, Chicago, Atlanta, Dallas, Columbus, San Francisco, Toronto, and London.* $5.28. viii + 582 + xlix pp.; ill. 1957.

There is something of startling interest to biologists in this new edition of a widely used high school chemistry textbook, which was first published in 1942 and is now "thoroughly revised." A very large amount of biological material has been incorporated. Of four major parts of the book, one is almost wholly devoted to biochemistry, and other biological relationships are touched on in Part III, Chemistry of the Home, and especially in Part IV, Chemistry of the Community. But Part II is really astounding.

Part II (201 pages) is devoted to the Chemistry of the Individual. It includes a consideration of the role of water in the human body, the chemistry of foods and nutrition, the hormones, the chemistry of disease, of drugs and medicines, of cosmetics, and of clothing, chemical hobbies, and vocations related to chemistry. There are many biological pictures and diagrams, but the discussion is rather didactic, elementary, and occasionally erroneous. For example, the oxidative utilization of glucose is said to be "accomplished" by insulin acting as a catalytic agent in the degradation of CO_2 and H_2O; there is no mention in this connection of hexokinase, the actual enzyme in the phosphorylation of glucose, and phosphorus in the body is relegated to the bones and teeth; there is no indication that the utilization of glucose is by numerous steps, no consideration of energy-rich phosphate compounds, no Krebs cycle or electron-transport system. The vitamins are treated in the conventional nutritional way, being left entirely unrelated to their real roles in the synthesis of such compounds as the pyridine nucleotides, flavins, or other coenzymes. There is, in other words, little real attention to the proper chemistry of life. On the other hand, one may read for pages on end without a hint that the book is not a standard elementary treatment of biology and hygiene. When a substance such as adrenalin (sic) is discussed, its physiological effects are described, but the only real chemistry in the account is the almost meaningless formula ($C_9H_{13}O_3N$). Would anyone recognize this as a derivative of an aromatic amino acid? The attitude appears to be, who cares? Proteins are said to be made up of 22 known amino acids, but not even a peptide bond is figured or so much as mentioned.

The authors have unquestionably had a very fine idea—to focus the study of high school chemistry on the stuff we're made of and the transformations of energy and matter in the living body, rather than on industrial chemistry, according to prevailing fashion. Most unfortunately, the execution of the idea might be described as an evisceration, the real chemistry having been evicted and an anemic biology stuffed into the hollow. This formulation cannot be excused on the basis of the difficulty of the subject matter. It clearly represents the loss of a point of view, a fundamental confusion between a chemical and a non-chemical point of view. Nothing in biochemistry could be more essential a concept, for example, than that of the nature and role of enzymes. But this is nowhere considered in a comprehensive light. Enzymes are depicted as significant in digestion, in hydrolysis, and other degradative work. But synthesis is seemingly not relevant, and the nucleic acids are nowhere mentioned. Biologists will be appalled at the consequences of this treatment, and chemists will justly feel indignant. Shall we try again?

BENTLEY GLASS

ECOLOGY AND NATURAL HISTORY

THE ECOLOGY OF INVASIONS *by Animals and Plants.* *By Charles S. Elton. Methuen & Co., London; John Wiley & Sons, New York.* $5.25. 181 pp.; ill. 1958.

This new volume by Charles Elton contains an excellent summary of well-documented cases of recent invasion of new communities. The book is an expansion of three BBC Third Program broadcasts given in 1957. As such, the material is slanted toward the interested layman rather than the professional ecologist, but even for a professional person it provides an excellent review of the literature on invasions. Elton's main aim is to present the case for "conservation of variety" in the ecological community. To this end he has selected examples and arranged them so as to illustrate the fate of invading species in communities of varying complexity, from the relatively simple communities of remote oceanic islands to the richer continental communities.

The modern explosive spread of species which is brought about directly or indirectly by man is emphasized in the chapter devoted to Wallace's Realms and their recent breakdown. Other chapters deal with interactions between populations and with food chain concepts. These discussions aid materially in explaining some of the factors which determine the success or failure of an invasion, but, as Elton points out, there are still a number of blank places in our understanding of the relationships between populations.

The conservation of a rich ecological community (a more stable one) is the subject of the last two chapters. The rest of the book would have been brought into sharper focus if these last two chapters

had preceded the others. They serve as a general statement of Elton's thesis: that "conservation of variety" is preferable to a simplification of the ecological community, on three counts. These are as follows: (1) there is a "right" relation between man and animals, from a religious point of view; (2) there would be a better opportunity for a richer experience of observing nature; and (3) ecological stability would be promoted and disastrous ecological "outbreaks" prevented.

Much evidence is cited to support the hypothesis that rigorous spraying programs in orchards may actually result in heavier parasite infestations than those which occur when the orchard community is allowed to strike a balance between its naturally occurring populations. Elton urges a thorough reconsideration of rigid monoculture practices and of the proposal to remove large sections of English hedgerows.

The accounts of the ecological invasions are accompanied by excellent maps that diagram the spread of the invaders. A number of good photographs also illustrate the species and the habitats mentioned.

MARGARET FOREMAN COHN

STUDIES ON LOCH LOMOND. I.

By Harry D. Slack and 6 contributors; foreword by C. M. Yonge. The University of Glasgow, Glasgow; Blackie & Sons, Glasgow. 15s. x + 133 pp. + 4 pl.; text ill. 1957.

This is the first volume of reports from the field station established on Loch Lomond in 1946 to conduct research on the biting midges of Loch Lomond. This program has been expanded to include many other facets of the limnology of the lake.

Loch Lomond is the fifth largest lake in the British Isles. It lies across the border of the Highland Fault, and is of particular limnological interest because of its basins which represent extremes of productivity, from the deep, relatively barren northern end of the lake to the shallow, richly productive southern end.

This volume, Number 1, contains papers on the topography of the lake, its physical and chemical characteristics, and a general treatment of the lake fauna, including a checklist of invertebrates. More detailed reports discuss the snails, the midges, the powan (*Coregonus clupeoides*) and the fish parasites. In addition to the chapters written by H. D. Slack, there are contributions by A. C. J. Weerekoon, W. Russell Hunter, J. W. H. Lawson, J. D. Hamilton, F. W. K. Gervers, W. O. Copland, and a foreword by C. M. Yonge.

MARGARET FOREMAN COHN

THE NATURAL HISTORY OF RENNELL ISLAND, *British Solomon Islands. Scientific Results of The Danish Rennell Expedition, 1951, and The Brit. Mus. (nat. Hist.) Expedition, 1953. Vertebrates. Volume 1.*

By Torben Wolff. Published on behalf of The University, Copenhagen and The British Museum (Natural History) London, by the Danish Science Press, Copenhagen. £2 5s. (paper). 228 pp. + 11 pl.; text ill. 1958.

Rennell and its small neighbor, Bellona, are the southernmost large islands of the Solomon group, and are perhaps the best examples in existence of uplifted coral atolls. Rennell still retains its original lagoon in the form of a large brackish lake. Both islands have a precipitous shoreline, the former offshore face of the reef, which now rises as much as 140 meters above the ocean. The islands are rather inaccessible, and only two expeditions of any magnitude have been made to them. One was a part of the Danish Galathea expedition in 1950–52, and the other, an expedition by the British Museum of Natural History in 1953.

The present report is published jointly by the University of Copenhagen and the British Museum, and deals primarily with the materials secured by the two expeditions. However, the literature on the islands is thoroughly reviewed, and other collections are noted. The publication is actually a series of articles written by various specialists of the two institutions.

Only 9 mammals are known from the islands. Eight of these are bats, including a new species of *Emballonura*. The ubiquitous Pacific Rat, *Rattus exulans*, is naturally present. Forty-six birds are recorded, but no new species are described. Ten reptiles are known, a new subspecies of *Laticauda laticauda* being described. No amphibians are known from the islands. Of the fishes, only an eel and a species of *Eleotris* occur in fresh water. Sixteen families of salt-water fishes are recorded. The most significant contributions are the descriptions of 3 new species of *Kraemeria*, one of *Istiblennius*, and one of *Entomacrodus*.

BRYAN P. GLASS

RESULTS OF THE PURITAN-AMERICAN MUSEUM OF NATURAL HISTORY EXPEDITION TO WESTERN MEXICO. *7. Corals and Coral Reefs in the Gulf of California. Bull. Amer. Mus. nat. Hist., Vol. 118, Art. 7.*

By Donald F. Squires. American Museum of Natural History, New York. $1.25 (paper). iv + pp. 371–431 + pl. 28–34; text ill. 1959.

AN ECOLOGICAL ANALYSIS OF THE AVIFAUNA OF ST. LAWRENCE ISLAND, ALASKA. *Univ. Calif. Publ. Zool., Vol. 63, No. 2.*

By Francis H. Fay and Tom J. Cade. University

of California Press, Berkeley and Los Angeles. $1.50 (paper). iv + pp. 73–136 + pl. 11–16; text ill. 1959.

EVOLUTION

THE FOSSIL BOOK. *A Record of Prehistoric Life. By Carroll Lane Fenton and Mildred Adams Fenton. Doubleday and Company, Garden City.* $12.50. xiv + 482 pp. + 8 pl.; text ill. 1958.

The Fentons should be congratulated for making this volume an excellent introduction to the history of life on the planet for those who are not geologists or paleontologists. Their subject is so vast and the body of knowledge so extensive it is a wonder that they have succeeded in condensing the biology of 2 billion years into something less than 500 pages.

This task is accomplished mainly by adhering to the fossil record at all points along the way. This primary position which the authors give to the *evidence* makes their story manageable, is scientifically sound, and gives the book a "field trip" flavor which has wide appeal. For example, Chapter XXI begins, "Near the crossroads called Fossil, Wyoming, rise cliffs of white marly limestone and pink shale. Their age is middle Eocene, and they settled in one of three lakes that spread across southwestern Wyoming and nearby parts of Utah and Colorado. The limestone, which is part of the Green River Formation, is famous for its abundant and well-preserved fish." From this starting-point the Fentons begin to summarize for us what is known about bony fishes. In a similar manner we are led into the systematics of ancient coelenterates, brachiopods, echinoderms, and other invertebrates. The second half of the volume is devoted to plants, amphibians, reptiles, and mammals, and their fossil history.

The discussions of ancient biology are admirably introduced by Chapter III, which takes up the subject of groups, names, and the classification of organisms. Here the novice cannot fail to appreciate the weaknesses of classification on the basis of "affinities" as well as the unifying progress that has been made through the employment of this concept.

In presenting the status of current knowledge and interpretation, the differences of opinion which often occur are briefly summarized and left unresolved. This might be somewhat unsatisfying to an expert, but to engage in extended controversy over the interpretation of Precambrian rocks, for example, might require a volume in itself. Here it is not out of place to note the usefulness of the bibliography of suggested reading included in the later pages. These afford another clue to the authors' success in condensation: where other books cover the subject better or in greater detail, the reader is referred to them, and the main theme of the story is unbroken.

An important feature of this book is its pictures, which include a few color plates, and photographs or drawings to be found on almost every page. Many of the photographs were taken by the Fentons in the field. Some of the color plates are spectacular, especially those of crinoids and fish which have been fossilized by the intrusion of brilliant minerals. The drawings have been done with great care and all of them seem to be new. Many of the drawings and restorations of invertebrates have been based on the Fentons' own work. These pictures, too, lend precision to the text, and stir the imagination of the amateur. The practical reasons for leaving out human paleontology are quite compelling, and give the work a unique "unfinished" quality that is not altogether unpleasing.

Chapter XXXIV, one that the amateur has been waiting for, includes a list of 18 or so museums in this country where one can see some of the best fossil collections, as well as a rather extensive list of suggested reading under such headings as History and Geologic Background, Textbook and Reference Works, and Guides for Collectors and Museum Visitors. There are even short paragraphs about where to collect fossils, the necessary equipment, and how to clean and prepare your specimens.

In short, if you would like to have your first (or second or third) glimpse of the record of prehistoric life, *The Fossil Book* will be rewarding.

CHARLES C. THOMAS

HYSTRICOMORPH RODENTS FROM THE LATE MIOCENE OF COLOMBIA, SOUTH AMERICA. *Bull. Dept. Geol. Univ. Calif., Vol. 32, No. 5. By Robert W. Fields. University of California Press, Berkeley and Los Angeles.* $2.50 (paper). Pp. 273–399 + 36 pl.; text ill. 1957.

The La Venta fauna, late Miocene, is the only reasonably well known Tertiary mammalian assemblage from South America north of Argentina. It therefore has great zoogeographic and phylogenetic interest. Rich collections made by R. A. Stirton and his associates in 1944–1950 are still under study at the University of California. In the present dissertation Stirton's former student, R. W. Fields, thoroughly monographs the rodents and also discusses broader stratigraphic and ecological matters.

The known rodent fauna consists of only 7 species, 2 of which are not precisely identifiable, but several are represented by exceptionally good materials. A new species of *Prodolichotis* is the earliest known true caviid and shows the family specializations already fully developed. The most abundant forms belong to *Scleromys* and *Olenapsis*, here transferred

to the Dinomyidae. Fields shows that a number of genera hitherto placed in the Heptaxodontidae and Capromyidae are better referable to the Dinomyidae, and he reviews that whole group. The ear region (including ossicles) of *Olenopsis* is described and proves unexpectedly to have a significant resemblance to the Erethizontidae.

The capromyids as a whole show regular and significant advances in several different lineages from late Oligocene to Recent. That fact and their widespread Neotropical occurrence suggest to Fields that capromyids can be used for precise correlation within that region. A meticulous statistical analysis of the La Venta forms, however, shows no appreciable changes through 700 meters of sedimentation. Correlation is with the Friasian of Argentina. The whole La Venta fauna is exclusively old Neotropical zoogeographically and has no elements whatever of late Neotropical or Nearctic affinities. Differentiation from contemporaneous and older, more southern faunas is only local in character.

GEORGE GAYLORD SIMPSON

GENETICS AND CYTOLOGY

HUMAN BLOOD GROUPS AND INHERITANCE.

By Sylvia D. Lawler and L. J. Lawler; foreword by R. R. Race. Harvard University Press, Cambridge. $1.50. viii + 103 pp. + 1 pl.; text ill. 1957.

The second edition of this pocket-sized handbook has brought up to date the treatment supplied in the original edition of the history, general principles, and techniques of blood grouping. Separate chapters are devoted to The A_1A_2BO Blood Group System, The Rhesus Blood Groups, The MNSs Blood Groups, and Other Blood Group Systems (including P, Kell, Lewis, Lutheran, Duffy, and Kidd. The Diego system, of particular ethnological interest, did not make this edition.) A chapter on the British National Blood Transfusion Service will be of interest to those hematologists and blood bank operators who may profit by a comparison of facilities, organization, and methods. The final chapter, entitled Blood Groups and Biology, will be of most interest to the general biological reader. The subjects there discussed, clearly but briefly, include antigen-antibody relationships; the linkage of blood group genes to other genetic loci (Lewis with Lutheran, Rh with elliptocytosis, ABO with the nail-patella syndrome); blood groups in apes and other primates, as well as in more remotely related mammals; the distribution and relative frequencies of blood group alleles in different human populations and races; the discovery of blood group mosaicism in dizygotic twins, occurring when primordial blood-forming cells from one twin obtain access through the placental circulation to the other, and become permanently established in the recipient; and finally, the use of the blood groups for exclusion of paternity or identification in criminal cases.

It is hardly necessary to say that the Rh terminology used is that of the Fisher-Race theory of closely linked or pseudoallelic Rh genes. Some of the more recent evidence bearing on this theory has been presented: the discovery of a woman homozygous for *D* and altogether lacking the *C*, *c* and *E*, *e* antigens, a case interpreted as a deletion in the chromosome of the two adjoining *C* and *E* sites; and secondly, the discovery in the United States of a new *f* antigen closely linked with, or a part of, the Rh locus, and interpreted by the authors as constituting further evidence of the divisibility of the Rh locus into subloci or pseudoallelic sites.

BENTLEY GLASS

ENURESIS. *A Clinical and Genetic Study. Acta psychiat., Kbh., Sup. 114, Vol. 32.*

By Bertil Hallgren. Ejnar Munksgaard, Copenhagen. D. Kr. 36.00 (paper). xii + 159 pp. 1957.

This study is based upon a total of 230 propositi in two children's hospitals of Stockholm, together with 702 parents or sibs of these propositi, of whom 172 were found likewise to have or to have had enuresis (all except 17 cases being nocturnal bed-wetting, or both diurnal and nocturnal). A high frequency was found among the parents and sibs, at an essentially equal level in the two groups of near relatives. There was a higher rate among sibs with affected parents than among sibs with unaffected parents, and a higher rate among relatives of persons with primary enuresis than among relatives of cases acquired secondarily. These relationships point to at least a partly genetic basis for enuresis. The analysis was unable to discriminate between a polygenic type of inheritance and one attributable to a single autosomal dominant factor with a penetrance of 75–80% among males and of 40–50% among females and modified by other genes, by environmental factors, or both.

BENTLEY GLASS

SYMPOSIUM ON NUCLEAR SEX.

Edited by D. Robertson Smith and William M. Davidson; foreword by Robert Platt. William Heinemann Medical Books, London; Interscience Publishers, New York. $3.50. xviii + 188 pp.; ill. 1958.

This symposium was organized and held in England during M. L. Barr's 1957 visit to that country. The participants, mostly English medical scientists, rep-

resented a cross-section of medical geneticists, mammalian cytologists, clinical pathologists, and clinicians interested in sex abnormalities. A total of 22 short papers were read, all dealing with various aspects of "nuclear sex." The symposium was divided into the following general categories: Cytological and genetic aspects of nuclear sex; Application to the study of intersex and related states; and Application to the study of tumors. A final general discussion is included, as well as some concluding remarks by Murray L. Barr.

As much as anything else, this symposium serves to define clearly the problems of nuclear sex. While it is quite clear that a distinct chromocenter occurs in much greater frequency in females than in males, no adequate cytological explanation of this has been forthcoming. Several hypotheses, however, were presented during this symposium. Also additional attention was focused on the techniques by which such cytological preparations are made, and on the general significance of obtaining better genetic data on patients with sex abnormalities. M. Danon is particularly informative concerning the development of human intersexes, and one wishes that more information on the genetics and embryology of mammalian intersexes was available. The section devoted chiefly to clinical observations illustrated how badly the nomenclature of sexual abnormalities requires clarification and revision, and how useful a tool nuclear sexing has actually been for diagnosing these conditions. The last section, dealing with nuclear sex in tumors, awakens particular interest in teratomata, a class of tumor which has been particularly notable because of its unusual powers of differentiation, inasmuch as it contains cell types characteristic of all three germ layers. The appearance of both classes of nuclear sex in well-defined areas of teratomas suggests once more the possibility that they may represent an abnormal aspect of a human embryo, resulting either from haploid parthenogenesis or genetic fusion at an abnormal site, rather than being simply an unusual type of tumor. Experimental work on the origin of these tumors is certainly to be desired.

This symposium will be useful to scientists dealing with any aspect of the field of sex determination and differentiation. Probably its greatest contribution is in setting forth the areas of greatest disagreement and confusion, where the most rewarding research opportunities exist.

RONALD R. COWDEN

DEVELOPMENTAL CYTOLOGY. *The Sixteenth Symposium of The Society for the Study of Development and Growth.* *Edited by Dorothy Rudnick.* *The Ronald Press Company, New York.* $7.00. vi + 215 pp. + 23 pl.; text ill. 1959.

Just before the turn of the century most cytologists were embryologists by training, and out of this background—sometimes referred to as the "golden age of biology"—names such as Weismann, Boveri, Driesch, Morgan, Conklin, and Wilson emerged. After at least four decades of a close affiliation of cytology with genetics, it is particularly gratifying to see cytologists once more concentrating on problems of importance to developmental biology.

In this symposium attention is given to ways in which modern cytological research may be focused on developmental problems. Each of the 9 contributions represents a distinctly different approach to the study of developmental problems, and utilizes a different biological system.

J. R. Preer discusses some of the genetic and immunological aspects of nuclear and cytoplasmic control of synthesis in protozoa, particularly his own immunological work on *Paramecium*. C. R. Partanen presents some considerations of chromosome (i.e., DNA) constancy and differentiation in plant cells, while giving particular attention to his work on the DNA content per nucleus in plant tissues and in tumors grown in vitro. T. C. Hsu discusses the somatic variation of chromosome number in mammals, particularly the numerical constancy of chromosomes grown in vitro and derived from mammalian tumors. The paper of George and Eva Klein deals with genetic and immunochemical work on mouse tumors, particularly as it applies to histocompatibility—a problem with which both workers have long been concerned.

The next two contributions discuss aspects of chromosome and nucleolar function seen by means of morphological and histochemical methods. Wolfgang Beermann discusses his work on the behavior of "puffs" in the giant salivary gland chromosomes during the development of *Chironomus*, while Hans Stich reports his cytochemical work on the nucleoli of *Chironomus* and *Acetabularia*.

Diter von Wettstein's contribution on the genetic control of the structure and growth of chloroplasts is an excellent example of the use of a multiple approach in treating a developmental problem; genetics and ultrastructure methods are alike brought to bear on chloroplast reproduction. Don W. Fawcett considers some of the changes in the organization of differentiating or growing cells which have been detected at the electron microscope level. He draws particular attention to the endoplasmic reticulum, the golgi complex, and intercellular cytoplasmic bridges in cells undergoing developmental changes. The last paper, that of Albert L. Lehninger, describes by way of illustration some enzyme systems that require the interaction of enzymes located in

different intracellular constituents or organelles. The glycolytic system affords the principal example.

This particular symposium of the Growth Society, in addition to maintaining its usual very fine standard of contributions, shows a cohesiveness which has been missing from some of the symposia of the recent past.

RONALD R. COWDEN

GENERAL AND SYSTEMATIC BOTANY

DIE GATTUNGEN DER RHODOPHYCEEN.

By Harald Kylin. C. W. K. Gleerup, Lund. Sw. Kr. 125 (paper). xv + 673 pp.; ill. 1956.

On December 16, 1949, a great phycologist, Harald Kylin, died. This author of most of our modern systematic knowledge of the Rhodophyta first wrote widely on all aspects of marine phycology, and later came to emphasize more and more the phylogenetic aspects of this one phylum. As he did so, he gradually withdrew from biochemistry, ecology, and taxonomy, in particular from the conventions of the latter. So much marked became his unconventionality that a notable contemporary, G. F. Papenfuss, was led to move the provision of a special nomenclatural rule (Article 34 of the 1956 International Code of Botanical Nomenclature) to accomodate such a lack of adherence to taxonomic convention as Kylin's. In the present, posthumous edition we now have in hand the final, admirable results of Kylin's life work, which he continued to perfect to the end and which has been devotedly extended and brought to a conclusion by his wife, Elsa Kylin.

In Mrs. Kylin's Foreword to the volume, the circumstances of the production of this exhaustive study are given. The text was first completed in 1944 for the second edition of Engler and Prantl's *Die natürlichen Planzenfamilien*. World conditions prevented its appearance at that time. It was further delayed by other circumstances from the time the author ceased revising it in 1949 and from the time Mrs. Kylin completed her work on it (apparently in June, 1954) until the final appearance of the volume under the date 1956.

Kylin treats the red algae as a class, using the German cognomen Rhodophyceen. He makes no reference to the generally accepted terms for a taxon of class (Rhodophyceae) or phyletic (Rhodophyta) rank. He does mention without comment the less widely used recent name Rhodophycophyta, but does not accept it, probably because he felt the red algae to be only a class.

Exhaustive presentations under the customary headings are made of nomenclatural and morphological data on the 558 recognized genera and the 3,740 species. Many new genera are discussed with no Latin diagnosis. The Index is mainly generic, but includes some species. There is a separate author index, and a bibliography with about 1800 references extending into 1954. The Table of Contents is an index in itself, since it includes page numbers for systematic groups as low as families, their characteristics, vegetative organs, reproductive organs, geographic distribution, and the separation of the group into subtaxa (e.g., generic keys).

Eighty-one pages are devoted to a résumé of general and special knowledge of the Rhodophyta. In this account, the general physiology, cytology, and anatomy of the two major subgroups recognized, the Bangioideae and Florideae, are discussed along with the systematics and details of the 5 orders and the genera in the 7 families of the Bangioideae. The discussion of the remaining 6 orders, components of the Florideae, requires 481 pages.

Kylin must be respected for his great ability in selecting criteria that distinguish between systematic groups. As in the cases of gonimoblast branching and auxiliary cell development, the criteria are often of little value for taxonomic purposes. Actually they may be difficult to apply even for systematic purposes, but they are certainly marvelous for the construction of phylogenetic theory. A notable inclusion in the *Nachtrage* by Mrs. Kylin is a phylogenetic scheme authored and published earlier by Jean Feldmann.

Each genus is treated in uniform style. The name is followed by a citation of the place of publication by author and date. The species Kylin accepts as the type is followed by synonyms both for the type species and the generic name. This material leads into a paragraph descriptive of the genus, which is followed by a brief paragraph giving the number of species, and the geographic area of the type and other species.

A number of novelties are introduced in the keys to families and genera. Some of these may prove difficult; others are refreshing innovations. The conventional criteria, such as cover cells in relation to tetrasporangia, or production of pericentral cells and modes of branch development, for distinguishing the families within the Ceramiales, are not used. Their separation is based largely on monopodial and sympodial branching of the thallus or gonimoblast. While the Ceramiaceae are easily distinguished on the basis of their lack of a covered gonimoblast at maturity, the remaining three families with a covered gonimoblast may not be so satisfactorily separated.

The text is extensively illustrated, but glaringly devoid of references to the illustrations. Most of the illustrations are of anatomical details; a few are habit drawings. It would have been nice, perhaps, if more habit sketches of the rarer genera had been included, for this treatise will certainly by a major

reference work for a long time. Actually omission of text references to the figures is not as great a handicap as it may at first seem, for usually the figures for a particular genus appear within a page or two of the pertinent text. However, in many cases this is not true. For example, *Seirospora* is discussed on p. 383. There is no figure nearby, nor any references to the figure of it on p. 63.

The unusual circumstances of the book's publication raise two deceptive features: an impression of incompleteness and an uncertainty as to authorship of particular portions. For example, *Gracilariopsis*, described by E. Yale Dawson in 1949, is not treated in the body of the text with the Gracilariaceae, but in the *Nachtrage*. It is apparent that in reading on any group one must check the index for material included in the *Nachtrage* (or elsewhere). Otherwise the 1956 publication date, when the main text was completed in 1949, will often cause the text to appear incomplete. Actually the volume is quite complete, at least in so far as it assembles references to the literature through 1953. In this volume, the opinions expressed on work published after about mid-1949 must furthermore not be accepted as the unusually good judgment of Professor Kylin, but rather as that of Mrs. Kylin or consultants.

Kylin uses groups of genera rather than the ranks of the International Botanical Code, such as "subfamily." This is evident, e.g., in the Rhodomelaceae where the taxon "subfamily" has been used at least since the appearance of the monumental monograph of this family by Falkenberg and especially when the groupings of the genera are not incompatible with previous usage.

Although costing, bound, about 3.3 cents per page (689 pages), it is an *indispensable* work, at least to marine phycologists.

This magnum opus is one which will certainly become recognized as the classic treatise of a group of not generally well-known but important organisms. It is recommended to casual inquirers and serious students alike. It is a magnificent compendium and an original treatment of observations and opinions, both of lasting value.

MAXWELL S. DOTY

FLORA OF PERU: *Myrtaceae. Field Mus. nat. Hist., Bot. Ser., Vol. XIII, Pt. IV, No. 2.*
By Rogers McVaugh. Field Museum of Natural History, Chicago. $3.75 (paper). ii + pp. 569–818. 1958.

ORCHIDS OF PERU. *Fieldiana: Bot., Vol. 30, No. 2.*
By Charles Schweinfurth. Chicago Natural History Museum, Chicago. $4.50 (paper). vi + pp. 261–531; ill. 1959.

These two paper-covered volumes may be reviewed together because they are much alike in many respects. Each of them treats, in a technical taxonomic way, a particular plant family as it occurs in Peru. The books are addressed primarily to botanists interested in the kinds of plants and their Peruvian distributions. McVaugh's treatment of the Myrtaceae for the *Flora of Peru* is one part of the large series started more than two decades ago by J. F. Macbride, which is intended ultimately to provide a complete coverage of the higher plants of that country. As such, it is somewhat limited as to style, conforming to that of the overall work. It is without illustrations.

On the other hand, Schweinfurth's *Orchids of Peru* is not strictly one of the "Flora" series, and is well illustrated. The illustrations are of high quality, often showing many technical details, as well as a habit sketch of the particular orchid species itself. This is the second of 4 volumes to be devoted to the orchid family.

Each book has resulted from prolonged and painstaking research on the part of its author. The presentation is very formal, and there is little or no discussion of the taxa given, but keys for seeking the identities of members of each family are present.

Both books are of considerable scientific value, partly because they are the first comprehensive taxonomic treatments of these plant groups for the Peruvian area. However, they are directed toward a limited scientific audience. These books have been executed by specialists and will remain standard references for many years to come.

REED C. ROLLINS

CONTRIBUTION À L'ÉTUDE MORPHOLOGIQUE ET ANATOMIQUE DU GENRE *Elaeoselinum* AU MAROC. *Trav. Inst. sci. Chérifien, Sér. Bot., No. 18.*
By J.-M. Veuillet. Société des Sciences Naturelles et Physiques du Maroc, Rabat. 480 fr. (paper). 63 pp. + 3 pl. + 1 folded map; text ill. 1959.

PLANT PHYSIOLOGY

PHYSIOLOGY OF FUNGI.
By Vincent W. Cochrane. John Wiley & Sons, New York; Chapman & Hall, London. $9.75. xiv + 524 pp.; ill. 1958.

The fungi are a conglomeration of extremely varied organisms, capable of metabolizing almost any natural compound. Consequently, any treatise on their physiology must cover a great deal of material common to other organisms as well as a large number of the bizarre reactions specific to the fungi. The present book represents a compilation of hundreds of references on the physiology of the Eumycetes,

Myxomycetes, and Actinomycetes, excluding only the more intensive work on the yeasts. The subject matter is treated almost entirely from a biochemical point of view, with the result that various related areas, such as morphological variability, evolution, ecology, and the economic importance of the fungi, are completely omitted. In his Preface, the author states that for lack of space he has not considered the genetics of the fungi, but contributions of genetics to the understanding of intermediary metabolism are nevertheless frequently included in the text.

A clearly organized and fairly detailed table of contents facilitates the location of any topic discussed in the book. The chapters include four on carbon metabolism, two on nitrogen metabolism, one each on vitamins and inorganic substances, and the remainder on the phenomena of growth and reproduction, the action of physical and chemical agents, and cell composition. In each chapter, the numerous references cited are made coherent by a running discussion of the special topic concerned. These discussions are relatively brief, summarizing results, pointing out the areas of most recent work and the pitfalls encountered, and usually concluding with a broad generalization of the current trend. Various graphs and diagrams selected from prominent papers contribute to the discussions, and these are further reinforced with figures of chemical structures and metabolic pathways.

Both subject and organism indices are provided. These, together with the succinct textual treatment, make the book a very handy and complete reference book for any chemical reaction occurring in fungi. Unfortunately, the book continues the unpleasant current custom of not citing the titles of the articles listed in the bibliography. One can only hope that this practice saves enough paper and printing to pay for the aggravation it causes the readers.

ANNETTE COLEMAN

LIGHT, VEGETATION AND CHLOROPHYLL.

By J. Terrien, G. Truffaut, and J. Carles; trans. by Madge E. Thompson. Philosophical Library, New York. $6.00. 228 pp.; ill. 1957.

This pocket-sized volume combines translations of two fine French works on photosynthesis, *Lumière et Végétation*, by Terrien and Truffaut, and *L'Énergie Chlorophyllienne*, by Carles. To be sure, these works were published some years ago, so the content of the book is not as up to date as its publication date of 1959 would indicate. Thus, it lacks reference to the work of Calvin and his group, or of Arnon or San Pietro, so that the discussion is still in terms of the Hill (light) reaction and the Blackman (dark) reaction, without indication of the existence of photosynthetic phosphorylation forming ATP (Arnon) or of the specific role of TPN as hydrogen acceptor in photosynthesis (San Pietro); and while phosphoglyceric acid is indicated to be the primary product, the interrelations of four-carbon, five-carbon, and seven-carbon sugars in the fixation of CO_2 and the formation of the three-carbon compounds are not clarified. Nevertheless, the work contains a great deal of valuable and interesting information about the role of radiation in photosynthesis, phototropism, and photoperiodism, and is well adapted for students and general readers who want a not too technical introduction to the subject. The price of the book, however, is excessive even for these times.

BENTLEY GLASS

ECONOMIC BOTANY

PLANTES ALIMENTAIRES ET VIE AGRICOLE DE L'AFRIQUE NOIRE. *Essai de Phytogéographie Alimentaire.*

By R. Schnell; preface by R. Combes. Editions Larose, Paris. 2,200 fr. (paper). 223 pp. + 16 pl.; text ill. 1957.

This book deals in considerable detail with food plants grown under varying conditions ranging from desert to tropics. The author is obviously well acquainted with both the plants and the peoples. The book covers the history and introduction of food plants and includes a catalog of the food plants of each country. An extensive bibliography and many photographs and illustrations are included. This work should be of interest to horticulturists and many botanists and food technologists, as well as to all who wish to know more about Africa.

G. J. RALEIGH

GROWING COTTON.

By V. R. Cardozier. McGraw-Hill Book Co., New York, Toronto, and London. $6.20. xxi + 423 pp. + 16 pl.; text ill. 1957.

This is a very interesting, inclusive, and well-organized book on the growing and handling of cotton. It is excellent for vocational students, for county agents, as a first approach to cotton growing for college students, and for growers and handlers of this crop. Technically, it is not as complete as the textbook *Cotton* by Ware and Brown, but it certainly makes an excellent supplement to their book inasmuch as it emphasizes the more practical aspects of cotton production and may be more comprehensive than other books on the same subject. It should find a ready acceptance among those who are interested in this important crop.

JULIAN MILLER

PLANT DISEASES DUE TO BACTERIA. *Second Edition. By W. J. Dowson. Cambridge University Press, New York and London.* $6.50. xvi + 231 pp. + 30 pl.; text ill. 1957.

This volume is a revision of the 1949 edition of the same title. The following subjects are included: general characteristics of bacteria and of plant disease; preparation, properties, and use of media; plant diseases due to species of *Corynebacterium, Pseudomonas, Xanthomonas, Pectobacterium, Erwinia,* and a few miscellaneous genera. There are also illustrations, references, and an index.

PLANT NEMATODES. *Their Bionomics and Control. By Jesse R. Christie. Agricultural Experiment Stations, Gainesville.* $3.75. xii + 256 pp.; ill. 1959.

This volume presents a vast assemblage of information gathered by the author during the greater part of his professional career. J. R. Christie is best known for his keen insight into the problems encountered by farmers all over the eastern part of the United States. Quite naturally the emphasis is on these problems. Nevertheless, as stated in the Preface, the author has not attempted to make the book a merely popular treatment but to write in such a manner that farmers, home gardeners, county agents, and others will be able to find in it useful information, presented primarily from the standpoint of a field pathologist. Taxonomic matters are definitely avoided. The book is well organized, consisting of an introductory chapter, a second chapter in which there is a very comprehensive general statement of principles and their application in the control of nemic diseases of plants, and 12 subsequent chapters dealing with the 23 major genera of nematodes known to parasitize plants and usually considered to be of pathogenic importance.

As each genus is discussed, a brief history and general statement, usually listing the species which will be discussed, is followed by an account of the general life history and habits, including all factors known to bear on the control and distribution of the species. This is followed by a consideration of the injury done to plants, of the hosts, and methods of control. Selected original references are cited at the end of each chapter. The Appendix may well prove the most useful part of the book to farm advisors, since it includes in tabular form information about regions where damage has been noted, field control measures, hot water treatments, and common and scientific names of the parasites and their synonymies. Typographical errors are very rare and the index is thorough. The author seems to have accomplished his purpose and the volume should have a wide distribution, although the extent to which it will be used by farmers and home gardeners is uncertain. Many of the modern, college-trained, large-scale growers will undoubtedly purchase it for reference use.

B. G. CHITWOOD

GENERAL AND SYSTEMATIC ZOOLOGY

GENERAL ZOOLOGY.

By Mary J. Guthrie and John M. Anderson. John Wiley & Sons, New York; Chapman & Hall, London. $7.50. xv + 708 pp.; ill. 1957.

All too many so-called revisions of textbooks consist in a few added passages and some reshuffling of material. That could never be said about this successor to the fourth edition of the standard zoology text by Curtis and Guthrie (1947). Those who have used that book, whether as student or teacher, will know what to expect here in the way of painstaking accuracy and clarity in presentation. Otherwise, the book is essentially a new one, although retaining certain admirable features of the old.

The first six chapters, which form a general introduction covering the structure and activities of cells, metabolism in vertebrates, responsiveness in vertebrates, reproduction and development in chordates, and heredity and variation, are from the hand of Mary Guthrie, and owe most to the book's predecessor. The remainder of the book is by the new co-author, and follows the classification of the animal kingdom into the major groupings of unicellular, acoelous, pseudocoelomate, and eucoelomate animals. The excellent summarizing chapter on the vital functions and organ systems of invertebrates has been retained in the plan, and in each chapter also the summarizing section on the body plan seen in the phylum or group of related phyla. One deficiency of the earlier textbook, the lack of any treatment of ecological relationships, has been remedied. The book closes with a chapter on the Evolution of Animal Life.

It may be fair to compare this excellent volume with another outstanding new zoology textbook, that by Gairdner Moment (1958). The Guthrie and Anderson is about 50 pages longer; but the Moment textbook has a larger, double-column page carrying more words—so the two books are about equal in length. Moment has adopted the protostome-deuterostome breakdown of the phyla, which is becoming commoner, and also the theory of Hadzi for the origin of the Metazoa from multinucleate ciliates, based on their resemblance to the acoelous turbellarians. Both books are well illustrated, the Guthrie and Anderson rather more conventionally. Moment has a very interesting chapter on Animal Behavior,

not matched by Guthrie and Anderson; and his treatment of the subject of evolution is considerably more modern than the consideration of evolutionary evidences and processes in the latter book. Both texts have made a strikingly successful effort to avoid needless technical terminology. Moment's treatment of the subject devotes considerably more attention to classic experiments and the history of the subject. Both books have about the same amount of biochemistry, but in the Guthrie and Anderson this is largely confined to Chapter 2, whereas in Moment's treatment it is more scattered—for instance, the pattern of glycolysis, the citric acid cycle, and the role of energy carriers such as ATP is taken up by him under the heading of respiration, in the chapter on Mammals. Neither book is an easy one for the student, but of the two possibly Moment's is more adapted for the general student and the Guthrie and Anderson for the zoology major. A choice between them is indeed hard to make. Certainly, each of them is far to be preferred to the conventional survey of the animals, phylum by phylum. On the other hand, neither one of these texts represents so sharply original a departure from convention as John Moore's *Principles of Zoology* (1957), with its emphasis on a careful selection of basic zoological concepts and a dynamic rather than static descriptive survey of types. Here is ample choice among good textbooks for anyone.

BENTLEY GLASS

LABORATORY MANUAL OF GENERAL ZOOLOGY (INVERTEBRATES).

By Chauncey G. Goodchild. Burgess Publishing Company, Minneapolis. $2.00 (paper). iv + 67 pp.; ill. 1958.

The author does not state the purpose of this very slender manual. The gross anatomy of 1 to 3 species in each of 7 invertebrate phyla, a few genetics problems, and some demonstrations (largely slides) constitute the laboratory work. Ten pages of questions on the exercises and some blank pages for notes complete the manual.

MITES, *or the Acari.*

By T. S. Hughes. The Athlone Press, London; Essential Books, Fair Lawn, New Jersey. $6.75. viii + 225 pp. + 52 pl. 1959.

Most readers anticipate that a book purporting to give a "general survey of the group from both a biological and anatomical point of view" will have either a fairly complete account of current knowledge well integrated and presented, or extensive new facts and theories, or, ideally, both. Despite the fact that the present book does not satisfy these criteria, it does have some desirable features. For the most part the 53 plates, each with a number of figures, are well done. The organization is logical and, in general, the anatomical discussions summarize and integrate results from many important sources, especially the older literature. The biological sections on free-living mites, animal associations, ectoparasites, endoparasites, plant parasites, and vectors give much information, but the subject matter itself is so diffuse that a discussion of these topics in a few chapters, rather than in several volumes, is bound to be disappointing to a specialist. The references cited at the end of each chapter are useful as a partial bibliography arranged by subjects. From reading this book both the beginner and the specialist can gain an indication of the meager state of knowledge now available on the Acari. Perhaps this is the greatest contribution the book has to make. If this publication stimulates acarologists to investigate with modern techniques the biology and anatomy of the many different kinds of mites, it will have been worthwhile.

The book is marred by many errors and inconsistencies. For example, on p. 83 the Rocky Mountain Spotted Fever tick is referred to as *Dermacentor andersoni* (Stiles, 1908) in the second line and as *Dermacentor venustus* (Banks, 1908) on the sixth line; Fig. 6, Plate XXXVIII has the tarsal claw arising from the tibia instead of the tarsus; on p. 1 it is stated that, "the mites fall into the following five suborders," but on p. 210 the sixth suborder Tetrapodili is included in the chapter on classification, with the suggestion that "these are best considered as a group of Trombidiformes"; on p. 111 the major divisions of the Oribatei are given as Apyctima and Pyctima, but on pp. 208 and 209 they are more properly listed as Aptyctima and Ptyctima. In addition to many similar errors and inconsistencies, the author has the unfortunate habit of presenting his material in such a manner that the uninformed may receive an incorrect impression. The first few lines of the book are a case in point. He says: "The free-living terrestrial mites occur at high altitudes and are very early inhabitants of partially formed soils on mountains. They extend down to the shore and, through an intertidal fauna, merge with marine forms; alternatively, by way of denizens of marsh and bog, they are continuous with a fresh water fauna." These statements might give the impression that the Acari are typical of high altitudes and that the more or less atypical forms "extend down to the shore. . . ." Another example of a true but confusing statement is found on p. 48: "*Trombicula irritans* (C. V. Riley, 1873) which occurs in North America, *akamushi* (E. Brumpt, 1913) in Japan and Formosa, and *hirsti* (L. W. Sambon, 1927) in Queensland, all attack man, and may act as vectors of rickettsial disease."

Of the 3 species mentioned, only *T. akamushi* is known as a vector of a rickettsial disease. In so far as the other two species are concerned, the evidence is overwhelmingly in favor of the hypothesis that they do *not* act as vectors of rickettsial disease. For the record it should also be noted that *Trombicula irritans* (C. V. Riley, 1873) is an invalid name and that Sambon's name should not be in parentheses, since he originally assigned the species *T. hirsti* to the genus *Trombicula*.

G. W. WHARTON

THE SPIDER FAMILY DICTYNIDAE IN AMERICA NORTH OF MEXICO. *Bull. Amer. Mus. nat. Hist., Vol. 116, Art. 1.*

By Ralph V. Chamberlin and Willis J. Gertsch. American Museum of Natural History, New York. $3.50 (paper). 152 pp. + 47 pl.; text ill. 1958.

This work is primarily taxonomic and consists of detailed descriptions of the 174 species which the authors treat in 8 genera. Thirty-five of the species are indicated as new to science. There are included both keys to all genera, and keys to the groups of species in the very large genus *Dictyna*. Accompanying the keys and descriptions are beautifully executed drawings of important structural characters, and outline maps indicating the distribution of the respective species.

A brief discussion is given of the position of this family in the taxonomic system and its relationships to the group now set off in the family Amaurobiidae. The authors indicate how the two families may be separated and show that it is not a matter of the presence or absence of trichobothria on the tarsi, as one might assume from a perusal of the keys made by Petrunkevitch. Contrary to the latter's statements, the members of this family may have tarsal trichobothria.

B. J. KASTON

GUIDE TO THE INSECTS OF CONNECTICUT. *Part VI. The Diptera or True Flies of Connecticut. Sixth Fascicle: March Flies and Gall-Midges. Bull. No. 87.*

Bibionidae, by D. Elmo Hardy; Itonididae, by A. Earl Pritchard and E. P. Felt; edited by Charles L. Remington. State Geological and Natural History Survey, Storrs. $2.50. (paper). xii + 218 pp. + 15 pl. 1958.

This is the sixth bulletin on the Diptera in a series begun in 1942. The relatively small number of species of the Bibionidae known to belong to this fauna are covered adequately by Hardy, the foremost authority on this group. The subfamily Lestremiinae is treated adequately by A. Earl Pritchard. The other subfamilies are covered by the original Felt manuscript, revised extensively by Jeanne E. and Charles L. Remington. The result is undoubtedly the best that can be done without a complete study of the group, and has been published in this way to stimulate such a revision.

This publication should prove very useful, especially to students interested in the taxonomy of the Diptera, and to entomologists who must identify specimens. The revision of the Felt work makes it more useful than the original upon which it is based.

NEELY TURNER

REVISION OF THE CHINESE MECOPTERA. *Bull. Mus. Comp. Zool., Vol. 116, No. 1.*

By Fung Ying Cheng. Museum of Comparative Zoology at Harvard College, Cambridge. $2.00 (paper). 118 pp. + 23 pl.; text ill. 1957.

In this revision of the scorpion-flies of China the number of known species from that area has been increased from 57 to 82 through the addition of 10 new species of *Panorpa*, 11 of *Neopanorpa*, and 4 of *Bittacus*. The Mecoptera have not been collected in the Far East as much as the Lepidoptera or Coleoptera; but even so, it is remarkable that the number of new species of so large and remarkable a type of insect from a reasonably well-known area could be announced at one time. It is enough to make one pause, and once again marvel at the seemingly endless variety of insect species.

THE LEAFHOPPER TRIBE ALEBRINI (HOMOPTERA, CICADELLIDAE). *Proc. U. S. Nat. Mus., Vol. 107.*

By David A. Young, Jr. Smithsonian Institution, Washington, D. C. Free upon request (paper). Pp. 127–277; ill. 1957.

A taxonomic treatment of 96 species and subspecies in 25 genera; 36 new species are described.

THE APHIDOIDEA OF THE MIDDLE EAST.

By F. S. Bodenheimer and E. Swirski. The Weizmann Science Press of Israel, Jerusalem. $12.00. vi + 378 pp.; ill. 1957.

A book with this title would generally be supposed to be a systematic or taxonomic study; but that is not the case in the present instance. This volume is essentially a biology of the aphids, with special emphasis on the ecology of the group. True, keys are given to families, genera, and species of the Middle East; and there is a Systematic List in addition. But some 170 pages are devoted to ecological aspects: life cycles; dispersal, orientation, locomotion, phylogenesis, and distribution; biometric studies; nutrition; aphid galls, honey dew, and relations to ants; the influence upon populations of climate and

weather, parasites, predators, and diseases; and problems of crop damage and control. There is a 20-page Bibliography and an Index.

Although relating particularly to the aphid fauna and ecological relations of aphids in the Middle East, this work will have a much wider usefulness than would appear from its title. The ubiquity of aphids and the general similarity of their life cycles and their relations to other organisms make an ecological review of the group very stimulating and valuable. Both Bodenheimer and Swirski have worked extensively on the group and lend the work a high degree of authority.

A Study of the Chironomidae (Diptera) of Africa South of the Sahara. *Part IV. Brit. Mus. (nat. Hist.) Entomol., Vol. 6, No. 11.*

By Paul Freeman. British Museum (Natural History), London. 30s. (paper). ii + pp. 263–363 + 2 pl.; text ill. 1958.

This systematic study deals with the Tribe Chironomini, Subfamily Chironominae. Keys to the tribes of the family and to the 7 genera included in the Chironomini are supplied. The genera treated, those with two posterior tibial spurs, are *Chironomus, Nilodosis, Henrardia, Stenochironomus, Collartiella, Paratendipes,* and *Nilothauma. Chironomus* is subdivided into 7 subgenera. More than 100 species are described, 25 of which are new (20 *Chironomus,* 2 *Stenochironomus,* 3 *Paratendipes*), and notes are given on 12 species of *Chironomus* described by Kieffer from females and not recognizable from the descriptions.

The Culicine Mosquitoes of the Indomalayan Area. *Genus Aëdes Meigen, subgenera Skusea Theobald, Diceromyia Theobald, Geoskusea Edwards and Christophersiomyia Barraud. Part IV.*

By P. F. Mattingly. British Museum (Natural History), London. 12s. (paper). 61 pp.; ill. 1959.

Hymenoptera of America North of Mexico; *Synoptic Catalog: First Supplement. Agric. Monogr., No. 2.*

Under the direction of Karl V. Krombein. United States Department of Agriculture, Washington, D. C. $1.75 (paper). ii + 305 pp. 1958.

This synoptic catalog has achieved the highest hopes of all those who welcomed its publication in 1951, for it has proven a workable, indispensable, and catalytic source book to the classification, distribution, and biology of our hymenopterous insects as known through the year 1949. Now, just seven years later, the first supplement has appeared to bring the catalog to an inclusive coverage through the year 1956. There are some 4000+ entries for specific and subspecific categories alone. Of these about one-fourth are of forms not listed in the original catalog, and of this fourth perhaps 80–85 per cent have been described since 1949. The other entries add to synonymies, extend the known ranges, and list new prey, host, and flower records as well as other biological information. Twenty-four new names are proposed, of which 22 are in the Ichneumonidae, 2 in the Diapriidae. Finally there is an Index, as well as a list of (surprisingly few) corrections to be made to the Index of the original catalog.

There are remarkably few errors, a witness that this volume, like that which it supplements, has cost its authors enormous labor. The catalog is so very nearly perfect, and so very useful, that it may seem over-demanding to suggest that it might include still more. Nevertheless, it would be extremely helpful to have some ready means of locating all the known hymenopterous parasites of an included species. As known hymenopterous hosts are now almost exclusively recorded as such only under the name of the parasite, it would seem a workable arrangement to add simple page references (perhaps in an identifying type-face) to all known hymenopterous parasites for each host species in the index of superspecific and trivial names. It would also be quite useful to have recorded here the first known date of capture within the chosen boundaries for all non-endemic forms, as well as authority for all extensions of range which are evidently extreme. However, whether such additions are one day to be made or not, this continuing catalog of our Hymenoptera is a marvelously useful, heroic work of scholarship. Karl V. Krombein and his collaborators in the Hymenoptera Unit of the Agricultural Research Division are putting a generation of entomologists in their debt by superb execution of the exacting task they have assumed.

Kenneth W. Cooper

Atlas des Hyménoptères de France, Belgique, Suisse. *Nouvel Atlas d'Entomologie. Volume 1. Tenthrèdes (Symphytes), Parasites (Térébrants), Porte-Aiguillon (Aculéates). Bethyloïdes. Volume 2. Porte-Aiguillon (Aculéates): Bethyloïdes (fin), Scolioïdes, Formicoïdes, Pompiloïdes, Vespoïdes, Sphécoïdes, Apoïdes.*

By L. Berland. Éditions N. Boubée & Cie., Paris. (I) 1,800 fr. (paper). 155 pp. + 18 pl.; text ill. (II) 1,800 fr. (paper). 184 pp. + 18 pl.; text ill. 1958.

An inexpensive colored atlas of Hymenoptera would be very helpful to many biologists and entomologists not yet well acquainted with the order but

who, for one reason or another, need help in rough placement of their specimens among the many families, or who need some idea of the habitus of an insect they seek. Berland's attractive little work, offering no less than 401 colored figures of Hymenoptera of many families, in addition to 71 ink drawings and 13 photographs, will perhaps satisfy the needs of many who wish amplification of this section of their Lutz or Swain pocket guides. American purchasers will not, however, find it inexpensive. La Vie Rustique, for example, charging ten dollars for the two fascicules (including mailing costs). Furthermore, those who contemplate its purchase should examine a copy first, for the plates, though pretty, show very little detail, and the pen drawings are no more than sketches in most cases. On the whole, however, there is good apportionment of the figures within the order, except that 43 of the colored illustrations of Volume 2 are of chrysidoids (which make up less than 1 or 2 per cent of a hymenopterous fauna) and will be of very little help.

The text briefly discusses the external morphology, reproduction (though the haplo-diploid sex determination is not so unique as Berland states), ecology, behavior, European distribution, and the collection of Hymenoptera. Keys to families are given, and there are very general descriptions of the families and comments on the biology of the forms included. The characterizations of genera and species are too brief and lacking in preciseness to be of value, but the biological notes are both useful and interesting (e.g., see that for *Mantibaria*, Vol. 1, p. 119). Like Seguy's *Atlas des Diptères de France*, Berland's little work should prove helpful in college libraries in the United States, for a majority of the included genera are common ones in our country. Nevertheless, for those who wish a very good and inexpensive, but more technical, atlas of Hymenoptera, I can think of none better than Gonzalo Ceballo's excellent *Las Tribus de los Himenopteros de España* (Madrid, 421 pp., 284 figs., 1941–1943). It will serve well the needs of any persons who wish large, accurate sketches (though uncolored) of a representative form from most subfamilies and tribes of the Hymenoptera.

KENNETH W. COOPER

SYSTEMATIC REVISION OF THE AUSTRALIAN DYNASTINAE (COLEOPTERA: SCARABAEIDAE).

By P. B. Carne. Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Melbourne. Free upon request (paper). 284 pp.; ill. 1957.

Nearly a century having passed since the broad classification of these scarab beetles was last considered, a thorough revision is indeed needed. From a very large series of specimens, the author has undertaken this task. As a result, "six new genera and 48 new species are described; three generic and 48 specific names are placed in synonymy, while 34 new combinations are proposed. All the endemic genera are recharacterized and all the previously known species redescribed. Keys at all classificatory levels are provided; at the species level it has often proved convenient to key the sexes separately. Altogether 173 species are recognized as occurring on the Australian mainland and adjacent islands; their morphology is illustrated by some 600 figures, their distributions by a series of maps." The author's ability to write clearly and succinctly is evident even from so brief a quotation as the above, taken from the Summary. In addition to the systematic revision of the subfamily, Carne discusses certain relationships of evolutionary interest. He concludes that the "oryctomorphid" genera of Lacordaire are polyphyletic in origin, with convergent specialization owing to adaptation to life in extremely arid environments.

FUNDAMENTALS OF ORNITHOLOGY.

By Josselyn Van Tyne and Andrew J. Berger. John Wiley & Sons, New York; Chapman & Hall, London. $11.75. xii + 624 pp.; ill. 1959.

Two distinguished ornithologists contributed to this superior textbook. Berger completed the manuscript after Van Tyne's death, in accordance with the latter's wish.

There are chapters on avian paleontology, anatomy, plumage, voice, distribution, migration, flight, feeding habits, breeding behavior, and social relations, all well-written and well-illustrated. The last third of the volume concerns the classification of birds. This long section quite obviously is the raison d'être of the book. To each of the nearly 170 families is devoted one page, which contains a good drawing of a representative species (by G. W. Sutton) and a succinct description under the headings: physical characteristics, range, habits, food, breeding, technical diagnosis, and classification (both by citation of a definitive reference) and general references to the group.

The other chapters are all very good, except perhaps in their perspective. While it is hardly fair to criticize a book for not being a text on avian biology when it purports to be only a text on ornithology, one may, however, note that for this reason it contains far less material of interest to the general biologist than it might have under the same title. For example, in spite of its great interest to biologists and even to non-biologists, the causes and mechanisms of bird migration receive only cursory notice. In the chapter on migration, navigation has but 5 pages devoted to it, and the material thereon

does not adequately convey an appreciation of the phenomenon, much less an understanding. On the other hand, the descriptive aspects of migration suffer no such deficiency. Characteristically then, there is an emphasis here on natural history, much to the neglect of development, genetics, and physiology.

The chapter on the senses and behavior is particularly good (except in its treatment of the senses, for these are briefly discussed in accordance with the lack in the literature). Berger has evaluated in an exceptionally lucid way the abundant data and theory concerning bird behavior. The theories of the several opposing factions of students of the subject are coldly, clearly, and fairly analyzed while somehow avoiding the usual semantic rigmarole.

The book is intended primarily for students, since it conscientiously begins to treat a topic at a level that requires little prerequisite knowledge of biology. A large glossary of specialized terms and a thorough index will facilitate its use by students. The book undoubtedly is one of the best within the scope set by the field of ornithology.

DAVID R. EVANS

MAMMALS OF NORTH AMERICA. *Volumes I and II. By E. Raymond Hall and Keith R. Kelson. The Ronald Press Company, New York.* $35.00 (set). (I) xxx + 546 pp. + 79 pp. index; ill; (II) x + pp. 547–1083 + 79 pp. index; ill. 1959.

Not for 100 years has there been an attempt to compile and present a unified summary of the mammals of North America. The authors of this edition are to be congratulated for the commendable results of their 13-year effort—the more so, when one realizes that the term "North America" includes everything from the Isthmus of Panama northward, and all of the West Indies south to, and including Grenada. The reader is especially urged to note Hall's chapter on Zoogeography, a fine exposition setting forth how the facts of classification and distribution may be synthesized into a whole that has ecological meaning for the present and evolutionary significance for the past.

In all, 1003 species of mammals are recognized. The method of treatment will be familiar to those who have followed the publications of the University of Kansas Museum of Natural History during the last decade. Many of these preliminary publications have been actually a part of this larger work. Familial relationships have been included in this work, however, and keys are supplied for the identification of families and genera as well as species. Infraspecific categories are neither characterized nor keyed, but they are listed by name and synonyms and have their marginal distribution records noted.

The authors have adhered strictly to the laws of priority, with the expressed feeling that to do so is the quickest route to nomenclatural stability. This, I think, will not invariably be so. For instance, priority demands that the genus *Odocoileus* be discarded as the appropriate name for the North American deer and the name *Dama* be expropriated from the fallow deer of Europe and Asia to replace it. To do so obviously creates more confusion than it removes; yet the authors use *Dama* despite the fact that petitions for the use of plenary power to retain *Odocoileus* and reject *Dama* are before the International Congress.

Another case in point: here was an excellent opportunity to produce order from chaos in the classification of American bears. Published authority is available in this matter for the use of almost any classification scheme ever conceived. In Couturier's book may be found a precedent for lumping all the brown bears and grizzlies of both Old and New Worlds into a single species. Other authors have offered less extreme modifications. Despite this, Merriam's classification, with its 87 named kinds, is perpetuated unchanged.

Aside from these criticisms, this book may be accorded rather unrestrained praise. A tremendous mass of information, much of it new, has been accumulated, assimilated, and organized into a useful whole. The distribution maps are most helpful not only in understanding the present distribution of species, but in giving useful leads to new investigation. It is an unhappy paradox that the new research for which this book will certainly provide a stimulus will in turn eventually render it obsolete. This is the unfortunate fate of any work that is a milepost in a process essentially continuous. This publication will certainly make the work of future students of the North American fauna much easier.

BRYAN P. GLASS

MAMMALS OF THE SAN FRANCISCO BAY REGION. *California Natural History Guides: 2. By William D. and Elizabeth Berry; illustrated by William D. Berry. University of California Press, Berkeley and Los Angeles.* $1.50 (paper). 72 pp.; ill. 1959.

This little book, one of a series of Natural History Guides, should be very effective in popularizing mammals for the residents of central California. Each mammal is depicted in pen-and-ink, and there is a brief description of its habits and chief points of identification. The drawings are superior; in addition, there are 8 full pages in color, reproducing excellent paintings by W. D. Berry. There are also suggestions to novices for beginning mammal-watching. All in all, this is a delightful little volume

and should well fulfil its purpose of creating a greater interest in nature.

BRYAN P. GLASS

THE MAMMALS OF IRAQ. *Misc. Publ. Mus. Zool. Univ. Mich., No. 106.*

By Robert T. Hatt. University of Michigan, Ann Arbor. $1.50 (paper). 113 pp. + 6 pl.; ill. 1959.

In Iraq, the cradle of the human race, for thousands of years mankind has been living off the land, hunting game, irrigating, grazing livestock, building great cities, and in other ways changing the face of nature. In surveying the mammals of this ancient land, Robert T. Hatt has attempted not only to consolidate the known records of the present mammalian distribution, and to contribute materially to them himself, but also to delve into the past, to draw from archeology, paleontology, and ancient history something of the local distribution of mammals in what paleontologists would call the "recent past."

The author more or less devises his own system of biotic districts for the country, and lists what mammals have been taken in each district. Most of the text is devoted to systematic accounts of the species found in Iraq. The synoptic list includes the currently accepted bi- or tri-nomen, the original citation, a listing of available specimens, with their measurements, the Arabic, Kurdish, Neo-Syriac, Turkish, and Persian names for the species (if known), and a brief discussion of the present status of knowledge of each form. Animals known to have occurred in Iraq, but extinct now, include the rhinoceros, bison, Siva giraffe, water buffalo, elephant, wild cattle, stag, beaver, oryx, lion, fallow deer, and onager. Threatened with extinction are the bear, leopard, cheetah, wild sheep, wild goat, roe deer, gazelle, lynx, caracul, honey badger, badger, marten, and squirrel. Some of these are threatened directly through hunting, others indirectly by a shrinking habitat. The last lions were killed along the Euphrates in 1916–18, and the last fallow deer were seen in 1917. Onager were last seen in 1927.

BRYAN P. GLASS

A TAXONOMIC REVISION OF THE SPOTTED SKUNKS (GENUS *Spilogale*). *Bull Amer. Mus. nat. Hist., Vol. 117, Art. 5.*

By Richard G. Van Gelder. American Museum of Natural History, New York. $2.00 (paper). iv + pp. 233–392; ill. 1959.

The genus *Spilogale* ranges from Costa Rica to the Canadian border, and consists of numerous allopatric forms, most of which have at one time or another been considered full species. In this study Van Gelder has reviewed the status of all the named forms, postulated their probable evolutionary history, and arrived at the conclusion that there are but two valid species, *Spilogale putorius* and *S. pygmaea*.

The most interesting part of the analysis seems to me to be the presentation of the color pattern, which is shown to consist of a single basic pattern in all forms, the variation between varieties involving a narrowing or a broadening of certain parts of the white stripes, or interruptions in and deletions from certain of them. It would seem that the allowance of full specific rank to *S. pygmaeus* on the basis of a lack of demonstrable intergradation is not fully sound, since only 4 specimens of the form are known. If one insists that intergradation must be demonstrated in order to justify relegation of a named form to the rank of subspecies, then it is true that in this case the proof is not at hand.

This is a taxonomic study in the best modern tradition, one that most taxonomists will agree is long overdue.

BRYAN P. GLASS

ECONOMIC ZOOLOGY

THE BIOLOGY AND CONTROL OF THE AMERICAN WHELK TINGLE *Urosalpinx cinerea* (SAY) ON ENGLISH OYSTER BEDS. *Fish. Invest., Lond., Ser. II, Vol. XXII, No. 10.*

By D. A. Hancock. Her Majesty's Stationery Office, London. 17s. 6d. (paper). ii + 66 pp. + 1 pl.; text ill. 1959.

ALL ABOUT TROPICAL FISH.

By Derek McInerny and Geoffrey Gerard; foreword by H. F. Vinall. The Macmillan Company, New York. $15.00. 480 pp.; ill. 1959.

All About Tropical Fish is another of the increasing number of books about what has become a most popular pastime and hobby. It contains all the necessary information for people who are beginners as well as for those who are more advanced collectors. The book includes 100 color and 200 monochrome illustrations and many diagrams. The title is somewhat pretentious, although many examples of freshwater tropical fish are described in the volume. They are perhaps not all so carefully treated as by some other authors. The book would be of more value if it contained more information about salt-water fishes, but the corresponding increase in price would doubtless place it beyond the buying range of most of the interested public.

Although *All About Tropical Fish* is certainly not everything there is to be said about tropical fish, it is a book that any persons who can afford the investment will enjoy reading and using.

TIMOTHY MERZ

FOOD HABITS OF MIGRATORY DUCKS IN ILLINOIS. *Bull. Ill. nat. Hist. Surv., Vol. 27, Art. 4.*

By Harry G. Anderson. Natural History Survey Division, Urbana. Free upon request (paper). iv + pp. 289–344; ill. 1959.

BREEDING AND IMPROVEMENT OF FARM ANIMALS. *Fifth Edition.*

By Victor Arthur Rice, Frederick Newcomb Andrews, Everett James Warwick, and James Edward Legates. McGraw-Hill Book Co., New York, Toronto, and London. $8.50. x + 537 pp.; ill. 1957.

The authors have produced a textbook which is both comprehensive and understandable and thus achieve their aim. The book contains much factual information; however, it poses enough questions not only to be enlightening but also sufficiently stimulating to evoke further inquiry. The field is a wide one and it has been covered rather completely. The Introduction actually covers even more than the field itself, in attempting to provide a biological background both general and particular, as well as to bring into focus the scope of the work. It seems to me it tries to do too much.

The text is divided into three sections: The Physiology of Reproduction; Mechanisms of Heredity and Variation; and Breeding Systems and Selection. These serve their purpose well. The treatment of reproductive physiology covers completely the anatomy and physiology as well as the practical circumstances of lowered fertility breeding practices and artificial insemination. The section on genetics, though spoken of as a review, will overlap a great deal with the course which precedes the one for which this text was written. The largest section of the book deals with breeding systems and selection. This is appropriate, for here are set down the applications of the principles and facts presented in the foregoing sections.

DONALD B. HEBB

IMPROVEMENT OF LIVESTOCK.

By Ralph Bogart. The Macmillan Company, New York. $6.75. xx + 436 pp.; ill. 1959.

This is a small, advanced volume which the author states was written for the student who has some knowledge of biology. He hopes that farmers and ranchers desiring information on this subject will find that the book contributes to their understanding and so will improve their breeding programs. With this hope in mind, he has undertaken to simplify the material.

There are 400 pages packed with genetic information, selection methods, breeding programs, research reviews, outlines of production improvement programs, and, interposed here and there, a few pages of statistical mathematics. Together with this, 21 pages of references are supplied. One cannot complain that there is too little information here. Indeed, by the time the ranchers and farmers have digested this and incorporated it into their breeding programs, Mr. Krushchev will be due for a revisit and an introduction to livestock whose IBM numbers will have more significance than those of the Princeton testing laboratories.

Though on numerous occasions the author states the need for simplicity in the selection program, by the time he has incorporated the genetic principles he has stated in the first portion of this book into his formulae for selection and has then presented the experimental data which prove it significant, enough variables have been introduced for the average farmer or rancher to have become lost. The reviewer finds himself in this position at times, in the midst of what seems to be an intensive course in applied genetics.

DONALD B. HEBB

ANIMAL GROWTH AND DEVELOPMENT

PHYSIOLOGY OF INSECT DEVELOPMENT. *A Report from The Developmental Biology Conference Series, 1956, held under the auspicies of the National Academy of Sciences—National Research Council.*

Edited by Frank L. Campbell. The University of Chicago Press, Chicago. $4.00. xiv + 167 pp.; ill. 1959.

The contents are arranged in six sections. Two of these are devoted to embryology and one each to larval development and tissue culture, metamorphosis and diapause, histolysis and tumors, and regeneration. Under these headings, however, the discussion wanders freely away from the indicated topics. No formal papers are included. The proceedings, apparently, are a nearly literal transcription of a conference held three years before publication, and consequently now badly out of date. That informality in discussion was the intention of the conference is clearly stated in the general introduction —but while this informality may have been a merit of the conference, it is much to the detriment of communication in print. In places the comments are flatly uninterpretable as they stand; and stand so

they must, for no references from which the comments derive are anywhere given. There are no indices, either to author or subject. The volume, therefore, is a dead-end. It can be of interest to and is interpretable only by those already well-informed on this subject, for whom it will be old stuff. One can but wonder at the reason for its publication at all.

DAVID R. EVANS

PIGMENT CELL BIOLOGY. *Proceedings of the Fourth Conference on the Biology of Normal and Atypical Pigment Cell Growth.*

Edited by Myron Gordon. Academic Press, New York. $13.50. xiv + 647 pp. + 11 pl.; text ill. 1959.

This volume is made up of the written versions of the talks and discussions that took place during the Fourth Conference on the Biology of Normal and Atypical Pigment Cell Growth held in Houston, Texas, in November 1957. Altogether there are 34 papers included, representing the current research work of some 58 investigators—embryologists, geneticists, biochemists, physiologists, dermatologists, pathologists, etc. The majority of the papers are concerned with mammalian melanocytes, especially those of man. Very little space is given to those of amphibians and fishes, and those of birds, unfortunately, are not dealt with at all. In view of the fact that the melanin-forming pigment cells play such a dominant role in the formation of neoplastic growth in many species of animals, including man, a considerable portion of the book (approximately one-third) deals specifically with melanomas.

While some of the papers contribute little that is new and serve mainly to reemphasize basic problems, many do open up new channels of thought and suggest new methods of attack. Although much has been achieved in pigment cell biology in recent years, as evidenced by the contents of the present volume, we have come to see that the problems involved in the growth and differentiation of pigment cells are far more complex than was at first thought. In spite of some gaps in our knowledge and certain inconsistencies between the results of different methods of study, we are nevertheless encouraged to believe that many of the gaps are on the verge of being closed.

The present volume and the two preceding ones, *The Biology of Melanomas* and *Pigment Cell Growth*, were made possible largely through the untiring efforts of Myron Gordon, who has done more than any other person to bring the important subject of pigment cell biology into prominence. His untimely passing has, indeed, left a vacancy that will not be easily filled. It is to be hoped that some successor can be found to carry on these periodic exchanges of information among workers in this important and extremely complex field.

MARY E. RAWLES

TROPHOBLAST AND ITS TUMORS. *Ann. N. Y. Acad. Sci., Vol. 80, Art. 1.*

By William B. Ober and 40 other contributors. The New York Academy of Sciences, New York. $3.50 (paper). 284 pp.; ill. 1959.

This publication includes the original papers and discussions of 40 participants in a conference held in October, 1958. The first section includes an historical orientation (W. B. Ober); an experimental and speculative discussion of implantation and trophoblastic invasion (B. G. Böving); observations on homoblastic implantation in the toadfish (P. S. Galtsoff); experimental observations on invasion and transport (R. W. Noyes); and data on the biological action of chorionic gonadotrophin (J. T. Velardo). This is followed by a section on the hydatidiform mole, including a discussion of old and new concepts of its morphogenesis and pathogenesis (H. W. Edmonds); problems of classification (J. Smalbraak); correlative studies on chorionic gonadotropin levels in patients with moles and chorionic tumors (E. Delfs); and a précis of clinical managements of such patients (C. L. Buxton).

The third section deals with trophoblastic tumors: chorioadenoma destruens (R. R. Greene); choriocarcinoma in females (W. W. Park) and in males (N. B. Friedman); a study of the geographical variation in the occurrence of trophoblastic tumors and of immunity and spontaneous regression of such tumors (W. A. Bardawil and B. L. Toy); and an exposition of the rationale, method, and results of treating patients with trophoblastic tumors by 4-amino-N^{10}-methyl pteroylglutamic acid (methotrexate), a folic acid antagonist (R. Hertz et al.).

The quality of the articles is good, and the book as a whole presents a convenient summary of what is known in the field and some information about experiments which are still in progress. It should be useful to clinicians and investigators of trophoblastic growths. The quality of editing, printing, illustrations, and format leaves little to be desired. Of particular value and interest are the data on the occurrence of trophoblastic growths in the Far East, giving the most authoritative figures yet available. Worthy of special mention are the thought-provoking contributions by Böving, Noyes, Edmonds, Delfs, Park, and Friedman. The volume is profusely illustrated.

Regrettably, the thorough bibliography by Bardawil and Toy is, unfortunately, not arranged in alphabetical order by author but retains the stupid order in which published papers happened to pop

into the heads of the writers! This arrangement renders the reference list practically worthless.

CARL G. HARTMAN

THIRD TISSUE HOMOTRANSPLANTATION CONFERENCE. *Ann. N. Y. Acad. Sci., Vol. 73, Art. 3.*

By John Marquis Converse and Blair O. Rogers and 75 contributors. New York Academy of Sciences, New York. $5.00 (paper). ii + pp. 541–868; ill. 1958.

Thirty-seven papers, reporting the findings of 75 investigators, make up this monograph, which is based on the third biennial Tissue Homotransplantation Conference held by the New York Academy of Sciences on February 6 and 7, 1958. It seems likely that before this review appears, a Fourth Conference will have been held.

The reviewer can do little more than call this important contribution to the attention of all those interested in the ever-widening circle of problems related to homotransplantation, an area of research which embraces, for example, the ontogenesis of the immune response, the behavior of transplanted embryonic tissues, specific desensitization of the delayed hypersensitive state, the chemistry and physiology of lymphoid tissues, and the passive transfer of homograft immunity by cells and serum. As might be expected, the quality of the articles is uneven. One wonders, in fact, whether the manuscripts are reviewed by competent referees before publication. The monograph would have been improved had about ten per cent of the articles been rejected. By and large, however, like the Academy's previous publications on the subject, the monograph is well worth reading. In fact, I know of no better source of information in this complex, rapidly growing field. The status of current research is reflected accurately; there are few omissions. The volume points up the changing character of clinical research, which has shifted to include studies of the fundamental mechanisms of clinical phenomena. In this field, in fact, it is often difficult to distinguish between "basic" and "clinical" research. Favorable mention should be made also of the international character of the book. In studies of homotransplantation important advances are now being made in the laboratories of Eastern Europe, the Czechoslovakian contributions being worthy of special mention. Finally it must be said that the volume suffers from the usual deficiency of the New York Academy's monographs: it lacks an index.

JAMES D. EBERT

IMMUNOLOGY AND DEVELOPMENT. *The Developmental Biology Conference Series, 1956.*

Edited by Mac V. Edds, Jr. The University of Chicago Press, Chicago; The National Academy of Sciences—National Research Council. $2.50. xii + 58 pp. 1958.

The scope of this report is quite broad, so that many of the topics treated are reduced to a 2- or 3-page synopsis. A more extensive treatment would have been greatly preferable, since more of the pertinent data could then have been included for evaluation by the reader. Topics such as the development and significance of antigens, cytotoxicity, acquired tolerance, and the homograft reactions are each considered briefly.

The editor has made an attempt to point out the existing problems and indicate where future research may be fruitful. However, publication should not have been delayed so long. Its postponement has greatly decreased the value of this book. Since the time of the conference considerable progress has already been reported in a number of the subjects treated. An example of such recent findings is the work concerned with the response of embryonic hosts to certain grafts. (See Ebert's review in *The Cell*, Vol. I, Academic Press, 1959.)

While the book is easy to read and should hold the interest of the general scientific public, its lack of specific references provides negligible guidance for further reading or personal evaluation of the conclusions stated. One of the more admirable features of the book is the frequency with which the reporter has pointed out pitfalls of various techniques and the controversial nature of the interpretation of experimental evidence.

Despite the small size of the volume and its disproportionate price, the book should serve as an introduction to the general coverage of work in immunoembryology through 1956. Many stimulating and interesting questions which were posed await further investigation.

HANS LAUFER

REGENERATION IN VERTEBRATES. *A Report from The Developmental Biology Conference Series, 1956.*

Edited by Charles S. Thornton. The University of Chicago Press, Chicago; The National Academy of Sciences—National Research Council. $3.25. xii + 108 pp.; ill. 1959.

This is another of the edited reports of the Developmental Biology Conference Series of 1956, organized by Paul Weiss. This particular conference is presented in published form as a short symposium on vertebrate regeneration. L. S. Stone, drawing on his extensive experience in this area, reviews the subject of retinal, iris, and lens regeneration. Some of his then current research and some miscellaneous observations bearing on the subject are included. Howard Holter reports on experimental work concerning the embryogenesis and regeneration of axial

mesodermal structures, particularly the trunk muscles. The second half of his paper discusses the development of striated muscles, as Holtzer and his group have studied them by using fluorescent labeled anti-myosin preparations. D. T. Chalkley has concerned himself with the lineage of blastema tissues. In his own research an attempt has been made to quantitate the morphogenesis of limb regeneration in urodeles, and his work to 1956, as well as that of others bearing on this problem, is presented. Marcus Singer discusses the influence of nerves on regeneration. The status of this problem, and some of his work relating to the avenues by which it may be profitably investigated, are described. H. A. L. Trampush reviews the information on the effects of radiation on regenerative capacity. Using radiation as a technique, a number of problems concerning the origin and capacities of regenerating tissue may be studied. O. E. Schotté's paper treating the influence of hormones on development was not submitted for publication, but the discussion of it, like that which followed the other contributions, was presented.

As in all of the books in this series, a major justifiable criticism stands out. The lateness of publication has reduced the usefulness of having the conference proceedings in published form. The literature cited, with the exception of Howard Holtzer's paper, in consequence carries the reader only to 1956. Perhaps it would be useful in the future, when symposia are organized, to submit participation on the following basis: when you come to talk, bring your manuscript with you.

RONALD R. COWDEN

ANIMAL MORPHOLOGY

PRACTICAL INVERTEBRATE ANATOMY. *Second Edition. By W. S. Bullough. Macmillan & Co., London; St. Martin's Press, New York.* $6.00. xiv + 483 pp.; ill. 1958.

As the author states, the preparation of this new edition was primarily motivated by the appearance of Jovan Hadzi's theory of the origin of the Metazoa which considers the acoelous flatworms to be the most primitive of the Metazoa. Accordingly, descriptions of an acoel (*Convoluta*) and a rhabdocoel (*Mesostoma*) have been added to the manual, and the order in which the groups that are concerned are discussed has been modified. The only other additions are of two nemerteans (*Amphiporus* and *Malacobdella*) and an endoproct (*Pedicellina*). As a consequence the book is 20 pages longer than before. Otherwise only minor changes have been made.

DAVID R. EVANS

STUDIES IN INVERTEBRATE MORPHOLOGY. *Published in Honor of Dr. Robert Evans Snodgrass on the occasion of his Eighty-Fourth Birthday, July 5, 1959. Smithson. misc. Coll., Vol. 137 (whole volume). Publ.* 4350.

Edited by J. F. Gates. Smithsonian Institution, Washington. $7.50. vi + 416 pp. + 49 pl.; text ill. 1959.

"Physiological studies can never progress beyond the speculative stage unless they have a firm morphological basis." This statement from Roeder's paper on the physiological approach to the host-predator relation concisely states the modern attitude towards anatomical studies. To this might be added that no other branch of biology will make any progress unless it too is supported by a solid morphological foundation. Since R. E. Snodgrass has had so much to do with the present recognition of the high value of morphology, it is fitting that this "festschrift" in honor of his 84th birthday should contain so many papers illustrating this. Snodgrass himself says that "anatomy is what you see with your eyes, morphology is what you think you see with your mind." With his mind's eye clear and alert, Snodgrass has looked at insects for many years. Some of the value of his work is to be seen in this book in which his name appears in the bibliographies of fully two-thirds of the papers.

The 19 papers include a biography and bibliography of Snodgrass prepared by Thurman. Some of the papers are likely to become classics, and every entomologist should have at least a borrowed copy somewhere about for reference. The papers cover all phases of entomology, including genetics, behavior, and embryology.

MYRON L. WOLBARSHT

THE ANATOMY OF *Laevapex fuscus*, A FRESHWATER LIMPET (GASTROPODA: PULMONATA). *Misc. Publ. Mus. Zool. Univ. Mich., No. 108.*

By Paul F. Basch. University of Michigan, Ann Arbor. $1.30 (paper). 56 pp.; ill. 1959.

COMPARATIVE ANATOMY.

By William Montagna. John Wiley & Sons, New York; Chapman & Hall, London. $6.00. xii + 397 pp.; ill. 1959.

This attractive textbook is intended for a single-semester college course in vertebrate anatomy. The publishers and author are to be congratulated for very readable type and clear, clean, useful diagrams. Montagna is at Brown University and, in a sense, is following the tradition of H. E. Walter, whose *Biology of the Vertebrates* was and still is read and

enjoyed by many. However, the two books are quite different.

Each chapter on organ systems is arranged with a general introduction, followed by a section on development aimed chiefly at mammals although occasionally, as in the chapter on muscles, broken down into the major vertebrate groups. The treatment of the development is followed by the comparative anatomy of the system, considered briefly under the separate categories of cyclostomes, fishes, amphibia, reptiles, birds, and mammals. Each chapter concludes with a numbered summary and a short list of suggested additional readings. There is a fairly extensive glossary without any guide to pronunciation, and the usual index.

The text is relatively free from the faults of a first edition. A few mislabels (e.g., cystic duct), an incomplete classification summary in Chapter 3, and a few innovations in spelling will keep the instructor who uses this volume on his toes. A more serious criticism is of the superficial way in which classification is handled. Most freshman textbooks are more thorough by far. Further, it is quite annoying to find in the treatment of the organ systems that all fishes are usually combined as a unit so as to lead to odd generalizations depending upon whether the author had the Chondrichthyes or the Osteichthyes primarily in mind. Sweeping statements are likely to be misleading. For instance, in the chapter on the digestive system in the section on reptiles the categorical statement is made that "a long hard palate separates the nasal passageways from the oral cavity, and the air is channeled directly to the pharynx." This unqualified comment surely puts the turtles in a sad fix. There are many more examples where a few qualifying adjectives would make matters more accurate.

This is potentially a very useful textbook, but it needs a little thoughtful revision leading to less categorical statements, a few more modifying adjectives, a bit of elaboration in spots, and certainly a careful consideration of the reader's reaction. The book will be welcomed as a basically sound volume. Montagna has put a wealth of good material into it, and the overall general excellence of the text tends to overwhelm the shortcomings that are largely a result of condensation.

IRA B. HANSEN

ANIMAL PHYSIOLOGY

MIRROR TO PHYSIOLOGY. *A Self-Survey of Physiological Science.*

By R. W. Gerard. American Physiological Society, Washington. $5.00. xii + 372 pp. 1959.

An undertaking to survey the field of physiology was initiated some years ago by the report of a committee of the American Physiological Society headed by Adolph. That report (*Fed. Proc.*, 1946) concerned an analysis of questionnaires completed and returned by more than 1000 physiologists. Members of the committee interpreted these and briefly expressed views regarding the present and future status of physiology in the United States.

Following the recommendations of this first committee, a second, headed by Ralph Gerard, was formed in 1946 to extend the study and to attempt to answer certain questions raised by the first survey. After a few preliminary activities, a final, very ambitious outline of a study was agreed upon in 1952. The group took advantage of the International Physiological Congress in Montreal, held in 1953, to hold a conference on the status of physiology in conjunction with foreign members; the proceedings of that conference were edited by Ilza Veith and published as *Perspectives in Physiology* in 1954, (*Q. R. B.*, 30: 299. 1955). Various subcommittees collected data from numerous sources, all of which are listed in appendices to the present volume. Parts of the project have been published as single papers elsewhere; and much of the data still remains unanalyzed, but it has been coded and filed for possible future use.

Mirror to Physiology includes the results of several projects, one of which is the interpretation of a questionnaire sent to "potential members of the population of physiologists." These were, among others, members of the American Physiological Society, American Society of Plant Physiologists, and the Society of General Physiologists; persons who indicated in *American Men of Science* or in the National Science Roster that they were physiologists; and persons whose doctoral dissertations (1948–52) were deemed physiological. Of the 7104 questionnaires sent out, more than 5000 usable ones were returned. By means of these it was hoped to define physiology and physiologists, by consulting "persons who professed the science."

The activities, employment, income, motivations, mobility, research activities, facilities and support; publications, society affiliations, and training of these physiologists are major topics covered in the volume. But these headings barely hint at the abundant material included under them. Additional chapters treat the history of the survey, draw conclusions, and present the recommendations of the committees. A final chapter considers the place of physiology in public education, in secondary schools, colleges, and via the popular press. No fewer than 25 appendices detail the personnel, methods, objects, and plan of the project. There is also an index. The physiologists who participated on the committees themselves constitute an almost adequate sample for such a survey.

Throughout the volume, the data and their interpretation are appropriately qualified, explained, and summarized. The style is crisp and clear. Though the final result falls far short of the original, overambitious goal, it is still quite impressive. The report should interest many biologists, since they rarely get to see any segment of their field so extensively dissected and so critically examined.

DAVID R. EVANS

ENDOCRINE CONTROL IN CRUSTACEANS. *A Cambridge Monograph on Experimental Biology.*

By David B. Carlisle and Sir Francis Knowles. Cambridge University Press, New York and London. $3.75. viii + 120 pp. + 5 pl.; text ill. 1959.

The authors of this review have made many contributions to our understanding of crustacean endocrinology. Their experience is reflected throughout the book in the form of numerous unpublished observations and insights which are not to be found in research papers. This book is undoubtedly the best current introduction to the subject and review of it. The chapter on the anatomy and histology of the neurosecretory systems is outstanding. The text is lucid, and the color plates and drawings could scarcely be improved. The longest chapter treats color change with disarming simplicity, in part by omitting some of the mystifying complexities, but largely by virtue of the organization and analysis of the subject matter. In this section also is found the meager information now available on the purification and identification of the crustacean hormones. The recently discovered pericardial organs and their action on the heart are briefly discussed. Sex, and the medley of growth, molting, developmental, and metabolic processes form the subjects of the remaining two chapters.

To survey this field is a somewhat discouraging experience, partly because the lessons to be drawn from vertebrate endocrinology are not being heeded. In all likelihood an understanding of the action of any one of these hormones would still be slow in coming, even if synthetic hormones were available. Yet attempts merely to standardize and purify hormone preparations have hardly begun. It seems fair to say that this field is characterized by a reluctance to acquire and apply the appropriate tools for the job.

DAVID R. EVANS

COMPARATIVE ENDOCRINOLOGY. *Proceedings of the Columbia University Symposium on Comparative Endocrinology held at Cold Spring Harbor, New York, May 25 to 29, 1958.*

Edited by Aubrey Gorbman. John Wiley & Sons, New York; Chapman & Hall, London. $15.00. xx + 746 pp. + 10 pl.; text ill. 1959.

The symposium of which this volume is the report was held in May, 1958. About 150 participants discussed or gave 43 papers. A small amount of the discussion after papers has been included. Some of the papers are reviews, but the majority are research reports.

Reproduction was the most popular topic, to judge from the number of reports. Many of the papers deal with lower vertebrates, including reptiles, amphibians, fishes, and even protochordates; some of these studies are comparative in the best sense of the term. There are also several papers on ecological and behavioral aspects of endocrinology. In general, the contents are representative of the interests of vertebrate endocrinologists in 1958. There are, however, only two papers on the chemistry of the hormones and there is practically nothing on the mechanism of hormone action. Also lacking is any treatment of plant or invertebrate hormones, and the interesting subject of pheromones (or exohormones). Indices to subjects and to animal types are included. Like many other symposia, this one is a somewhat biased aggregate of good 1958 papers in endocrinology.

DAVID R. EVANS

LABORATORY MANUAL FOR VERTEBRATE PHYSIOLOGY. *By Donald M. Pace, Benjamin W. McCashland, and Carl C. Riedesel. Burgess Publishing Company, Minneapolis.* $4.00 (paper). xiv + 281 pp.; ill. 1958.

In this large manual there are 11 exercises on muscle, 8 on nerve, 7 on receptors, 19 on circulation, 6 on respiration, 7 on nutrition and digestion, and 6 on hormones; usually there are several experiments in each exercise. Lists of the required apparatus and sets of questions are included in each exercise.

HÉMODYNAMIQUE RÉNALE.

By P. Mériel, F. Galinier, S. Ribaut, and J.-M. Suc. G. Doin & Cie., Paris. 1,500 fr. (paper). 159 pp.; ill. 1956.

This is an unusual book which makes readily available a substantial body of information concerning renal hemodynamics and renal functions. The subject matter is divided into two major parts. The first, on physiology, includes the following sections: anatomy; histophysiology (a rather brief summary); glomerular filtration and renal blood flow, with a very useful discussion of the nitrous oxide method; pressure relationships and renal resistances; renal interstitial fluid and lymph; functional circulatory, neural, and endocrine relationships; and renal pharmacodynamics. The second part, on pathology, is concerned mainly with renal hemodynamics in the following clinical situations: cardiac failure, hyper-

tension, renal disease in pregnancy, glomerulonephritis, pyelonephritis, shock, and acute renal failure or acute tubular necrosis.

The text is presented essentially as an outline, although critical comments are numerous. Very helpful diagrams are included, and the bibliography is excellent. This is a most useful and intelligibly written summary of renal physiology and functional pathology considered from the circulatory aspects.

F. P. CHINARD

CLARK'S APPLIED PHARMACOLOGY. *Ninth Edition.* *By Andrew Wilson and H. O. Schild. Little, Brown & Company, Boston.* $10.00. xii + 750 pp.; ill. 1959.

In this new edition of this standard textbook in pharmacology, the authors have attempted to preserve the characteristic features of a book in which the original author, A. J. Clark, presented the subject of pharmacology in relation to the cognate disciplines of physiology and medicine. That the volume has now gone into its ninth edition testifies to the high esteem in which it is held by pharmacologists. The authors have succeeded admirably in retaining the clearness, conciseness, and felicity of diction which characterized Clark's earlier editions.

The general plan of approach to the subject of pharmacology employed by the late Professor Clark has been retained. The treatise introduces the subject by a discussion of the general principles of drug action, followed by a chapter on the administration of drugs. These are followed by 24 chapters in which drugs acting on various systems of the body are discussed. An especially valuable feature of these chapters is a brief introductory discussion of the physiological functions of each system. Finally, the last 8 chapters in the book are devoted to drugs used in the treatment of infections, disinfectants, and the pharmacology of the skin. New chapters on the pharmacology of tuberculosis and on psycho-pharmacology are attractive additions to this edition.

Brevity is one of the characteristics of this text. The authors do not attempt to cover the vast array of drugs in the great detail characteristic of American textbooks on this subject; instead, they constantly emphasize pharmacologic principles, an approach which seems especially valuable for students in the medical sciences.

The volume is attractively printed on durable paper, profusely illustrated with diagrams, tables, structural formulas, and many photographic reproductions. It is highly recommended as an authoritative and concise treatise embracing the essentials of pharmacology.

JOHN C. KRANTZ, JR.

LABORATORY GUIDE IN PHARMACOLOGY. *By Harald G. O. Holck, Tom S. Miya and 2 other contributors. Burgess Publishing Company, Minneapolis.* $3.50 (paper). viii + 115 pp.; ill. 1959.

These authors formerly published a pharmacology laboratory manual for pharmacy and dental students; this one is a revision of it which is intended for more general use. Apparently laboratory assistants are expected to supplement the directions extensively, for they are rather sparse. Each of the major drug categories is demonstrated by several experiments. Although many of the experiments are quite sophisticated, usually only simple apparatus is required.

BIOPHYSICS AND GENERAL PHYSIOLOGY

MACROMOLECULES IN CELL STRUCTURES. *The John M. Prather Lectures, 1956.* *By A. Frey-Wyssling. Harvard University Press, Cambridge.* $5.00. viii + 112 pp. + 12 pl.; text ill. 1957.

It is universally accepted, now that the electron microscope and other physical tools have revealed domains of entirely new cellular dimensions, that organized structure goes hand in hand with organized function. In the living cell, organized structure has come to mean macromolecules: proteins, nucleic acids, lipids, carbohydrates, and the numerous combinations of all these, each having an almost infinite potential variety, and each entering into some more or less permanent organelle of the cell.

This is an area of biological, and particularly botanical, research which has interested Frey-Wyssling for over thirty years, and much of our information and stimulation regarding the fine structure of plant cells has come from his laboratory. In this volume he deals with the latest available data on the molecular organization of starch grains, cell walls, and chloroplasts, and with the problem of the growth and differentiation of cell walls. Frey-Wyssling makes it quite evident that a new biology is emerging, one more nearly akin to chemistry, physics, and crystallography than it is to the biology of even a decade ago, a biology that concerns itself primarily with the biosynthesis of macromolecules. It is not an easy field for the conventionally trained biologist, nor indeed is this book easy to assimilate and to comprehend fully, but it is equally evident that the information now emerging is a growing part of a corpus of data which we must understand if we are to comprehend the cell in all of its manifold aspects and activities.

C. P. SWANSON

ECHOES OF BATS AND MEN. *Seeing with Sound Waves. Science Study Series S1.*

By Donald R. Griffin. Doubleday & Company, Garden City. 95 cents (paper). 156 pp.; ill. 1959.

This paperback is one of the Science Study Series designed to present an effective picture of modern physics to secondary school students and laymen. It is a modified version of Griffin's well-known book on echo location—*Listening in the Dark*. As might be expected, the emphasis is on the physical principles of echo location rather than on the biology of bats. After underlining the importance of echo location in porpoises and bats Griffin discusses the propagation of sound in different media, its reflection and dispersion by different obstacles, and the effects of frequency and pulse duration on the detection of echoes. He suggests many ingenious experiments and demonstrations of acoustic principles, using equipment such as party "crickets" and parabolic desk lamp reflectors. There is repeated emphasis on the quantitative information that can be derived from these simple demonstrations. This leads to a discussion of sonar and radar, and the still more sophisticated echo location by bats. It is pointed out that a fuller understanding of the feats of orientation shown by bats and porpoises would be of great value in improving man-made echo-locating techniques and in assisting the blind. The material in this book would be of extraordinary interest to the latter, and it is hoped that it will be republished in a form available to them.

If the reader's interest is stirred by this book, he should turn at once to *Listening in the Dark*, which is one of the most brilliant, lucid, and absorbing scientific books of recent years. The great merit of both books is that in them the conventional boundary between physics and biology has completely disappeared. The student of elementary physics is shown that the generalizations of physics are not merely a set of laws to be obeyed but are powerful tools for the solution of concrete problems. The beginning biologist finds that the horizontal and vertical relationships of animals are not merely a matter of morphology, but are exciting realities when examined in terms of function and measurement.

KENNETH D. ROEDER

ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. *Volume VI.*

Edited by Cornelius A. Tobias and John H. Lawrence. Academic Press, New York. $16.50. x + 639 pp. + 1 folding chart; ill. 1959.

The greater portion of the articles in this volume are concerned with uses and effects of electromagnetic radiations in one form or another: the induction of lysogenic bacteria to produce phage by x-rays, gamma rays, and ultraviolet irradiation (Marcovich and Latarjet); microspectrography (Thorell); effects of ionizing radiations on tumors (Scott); fallout from nuclear weapons tests (Dunham); the measurement of blood flow, using radioactive inert gas (Freygang and Sokoloff); measurements of DNA and muscle protein by light-scattering techniques (Geiduschek and Holtzer); and ionizing radiations and cell injury (Howard-Flanders).

Ion and water transport in the stomach and intestine (Durbin, Curran, and Soloman); artificial and induced periodicity in living cells (Zeuthen); and the study of diabetes, using isotopic tracers (Berson and Yalow), are subjects also covered in this volume. The use of ultra-sound in the investigation of the central nervous system (Fry) is discussed in a very complete and interesting fashion.

All of the above articles are restricted to research in one field, although they are designed for the beginner as well as the specialist in that type of work. However, the section on Radiological Contrast-Enhancing Methods (Jacobson and Mackay) will be useful to almost all laboratory workers. The term "radiological" in the title is here misleading, for the article discusses contrast in its broadest aspects, from the contrast mechanisms inherent in the eye to electronic methods of exaggerating the existing contrast in an image. Anyone who has struggled to make a low contrast record into a high contrast print suitable for publication will appreciate the advice given in this article both in regard to the cure and the avoidance of this problem.

The book is profusely illustrated. The author index and a very complete subject index add much to the value of this volume.

MYRON L. WOLBARSHT

STRAHLENDOSIS UND STRAHLENWIRKUNG. *Tafeln und Erläuterungen unterlagend für den Strahlenschutz. Second Edition.*

By B. Rajewsky and 8 other contributors. Georg Thieme Verlag, Stuttgart. DM 36. xvi + 280 pp. 1957.

As the title implies, the second edition of this book is a corrected and enlarged version of the first edition, which was published in 1954. The authors have strived to provide in the most concise form the basic data of concern to the subject of radiation protection. About half of the book (280 pages) is taken up by an extensive and selected bibliography with a subject cross-index; the remaining half is about equally divided between the tables and the brief introductory and explanatory notes concerning

them. The subject matter is divided into 14 sections ranging from a short survey of radiation, radiation reactions, and radiation damage to atom-bomb explosions. The results of observations on acute radiation sickness, single acute whole body exposure, the influence of fractionation and protraction of dose, partial body irradiation, organ reaction, blood and blood-forming organs, radiation cancer, radiogenetic effects, relative biological effectiveness, maximum permissible levels, and the definition of the more common radiological units and abbreviations are synthesized in laudable didactic form for easy access and readability. The tables and graphs are carefully annotated with the relevant bibliography. This volume ought to be of aid to workers in the field, especially those who have entered it recently.

L. D. Marinelli

Bibliography on the Effects of Ionizing Radiations on Plants, 1896–1955.

By Arnold H. Sparrow, John P. Binnington, and Virginia Pond. Brookhaven National Laboratory, Upton, New York. $2.25 (paper). vi + 222 pp. 1958.

Perhaps the best review of this publication is supplied by the Introduction itself, since it gives a most accurate description of the work and its value. "The lack of adequate bibliographies, abstracts, and reviews at a time when interest in radiobotany is rapidly expanding should make this compilation of great value not only to newcomers in the field but even to established investigators. It offers a detailed and comprehensive coverage of the literature beginning with the early work in radiobotany and including the more recent developments (through 1955) on the peacetime uses of atomic energy in plant science." The *Bibliography* includes an explanatory introduction, a list of conferences, congresses, and symposia, a list of abbreviations of periodicals, as well as an exhaustive list of references and a subject index. It is a publication not only of value to those interested in the radiobotanical literature but also in the more general radiation literature.

Timothy Merz

BIOCHEMISTRY

Brief Course in Organic Chemistry. *Second Edition.*

By Lyell C. Behr, Reynold C. Fuson, and Harold R. Snyder. John Wiley & Sons, New York; Chapman & Hall, London. $5.75. x + 289 pp.; ill. 1959.

To secure brevity in a short course in organic chemistry, two methods are available: (1) to reduce the number of topics covered, or (2) to diminish the amount of material given under each topic and the number of reactions of each species discussed. The authors of the present text have relied mainly on the latter method. The text which results seems kaleidoscopic at times. A student using it without supplementary material from a skilled teacher might fail to understand some of the points which are presented at greater length in standard textbooks. Perhaps a superficial knowledge is all that is required of students in agriculture, home economics, dentistry, medical technology, pharmacy, nursing, and veterinary medicine, but for premedical students a more thorough grasp seems advisable. For an abbrieviated course, the method chosen has the advantage of accomplishing the objective of presenting the structural formulas of many compounds of practical importance "to students who will have occasion to use the substances in the professions for which they are preparing."

The quality of the workmanship shown in the book is good, and the illustrations are generally of good quality and well chosen to clarify three-dimensional relationships.

Alsoph H. Corwin

Annual Review of Biochemistry. *Volume 27. Edited by J. Murray Luck; associate eds., Frank W. Allen, and Gordon MacKinney. Annual Reviews, Palo Alto.* $7.00. viii + 775 pp. + 1 pl.; text ill. 1958.

Contents: Impressions of an Organic Chemist in Biochemistry (H. T. Clarke); Chemistry of the Carbohydrates (R. E. Reeves); Newer Developments in Relation to Protein Biosynthesis (H. Chantrenne); Biochemistry of the Protein Hormones (O. K. Behrens and W. W. Bromer); Biochemistry of Viruses (G. Schramm); Biochemistry of Cancer (H. E. Skipper and L. L. Bennett, Jr.); Chemistry and Biochemistry of Antibiotics (E. B. Chain); Biochemistry of Fishes (H. L. A. Tarr); Carbohydrate Metabolism (M. F. Utter); Water-Soluble Vitamins, Part I (H. P. Broquist); Water-Soluble Vitamins, Part II (C. H. Lushbough and B. S. Schweigert); Water-Soluble Vitamins Part III (H. P. Sarett and A. B. Morrison); Fat-Soluble Vitamins (S. R. Ames); Nutrition (N. S. Scrimshaw, G. Arroyave, and R. Bressani); Enzymatic Metabolism of Drugs and Other Foreign Compounds (B. B. Brodie, J. R. Gillette, and B. N. La Du); Biological Oxidations (J. B. Neilands); Proteolytic Enzymes (G. H. Dixon, H. Neurath, and J.-F. Pechère); Biosynthesis of Cholesterol and Related Substances (G. Popják); Amino Acid Metabolism (M. J. Coon and W. G. Robinson); Enzymology of Nucleic Acids, Purines, and Pyrimidines (L. A. Heppel and J. C. Rabinowitz); Meta-

bolic Antagonists (W. Shive and C. G. Skinner); and Biochemistry in the U.S.S.R. (J. A. Stekol).

HETEROCYCLIC COMPOUNDS. *Volume 5. Five-Membered Heterocycles Containing Two Hetero Atoms and Their Benzo Derivatives. Volume 6. Six-Membered Heterocycles Containing Two Hetero Atoms and Their Benzo Derivatives.*

Edited by Robert C. Elderfield. John Wiley & Sons, New York; Chapman & Hall, London. (Vol. 5) $20.00. vi + 744 pp. 1957. (Vol. 6) $25.00. viii + 753 pp. 1957.

Volume 5 treats the chemistry of 1,3-dioxolane and its derivatives, the pyrazoles and related compounds, indazoles, imidazoles and condensed imidazoles, oxazole and its derivatives, benzoxazoles and related systems, isoxazoles, and thiazoles and benzothiazoles. Among these compounds, biologists will be most interested in the pyrazole relatives of the pyrroles, a group including antipyrine; in the imidazole group, certain members of which are now known to be involved in the biosynthesis of the purines and of histidine, and which also includes histamine and the hydantoins, including allantoin; and in the thiazoles, which include such representatives as sulfathiazole and the thiazolium compound thiamine (vitamin B_1).

Volume 6, in an equally authoritative manner, treats the six-membered heterocyclic compounds: the monocyclic dioxanes, benzodioxanes, sulfur analogs of dioxanes, pyridazines, cinnolines and related compounds, phthalazine and its derivatives, pyrimidine and its derivatives, quinazoline, the pyrazines and piperazines, the quinoxalines, monocyclic oxazines, benzoxazines, thiazines and benzothiazines, and phenazines, phenoxazines, and phenothiazines. Without much question, in this volume it will be the chapter on the pyrimidines (by G. W. Kenner and Sir Alexander Todd) that will be thumbed to a dirty gray, in any biological laboratory.

Both volumes are well-indexed and cover their subjects through 1955. The 20-odd authors are recognized as authorities in their respective fields and the entire work may be expected to remain the definitive work on the subject for some years.

THE TERPENES. *Volume IV. The Triterpenes and their Derivatives: Hydrocarbons, Alcohols, Hydroxyaldehydes, Ketones, and Hydroxy-ketones.*

By the late Sir John Simonsen and W. C. J. Ross. Cambridge University Press, New York. $13.50. ix + 524 pp.; ill. 1957.

THE TERPENES. *Volume V. The Triterpenes and their Derivatives: Hydroxy Acids, Hydroxy Lactones, Hydroxyaldehydo Acids, Hydroxyketo Acids and the Stereochemistry of the Triterpenes. With Addenda to Volume III.*

By the late Sir John Simonsen and W. C. J. Ross; with Addenda to Volume III by Sir John Simonsen and P. de Mayo. Cambridge University Press, New York and London. $15.50. ix + 662 pp.; ill. 1958.

Although primarily of interest to organic chemists, these volumes contain references to the sources, mostly in plant materials, of a great many interesting and unusual compounds, especially the sapogenins and saponins. Who can say when some one of these may not become as important to us as the once unknown antibiotic compounds or the substances involved in vast industrial uses? Triterpenes were first described in 1788, but their structure has been elucidated only in the past two decades, especially through the work of Ruzicka and his collaborators. Squalene, found in shark liver and other fish-liver oils, is one of the few compounds of this isoprene class known to occur in animals. In plants, however, they occur in all parts, roots, leaves, stalks, flower parts, and seeds, and especially in resins and waxes of the higher plants; and related compounds are isolable from fungi. The biological significance of these compounds seems to be largely unexplored.

THE ALKALOIDS. *The Chemistry of Natural Products. Volume 1.*

By K. W. Bentley. Interscience Publishers, New York. $4.00. vii + 237 pp.; ill. 1957.

This photo-offset treatise has been prepared by the author, Professor of Chemistry at the University of Aberdeen, to fall halfway between elementary textbooks of the organic chemistry of natural compounds and the advanced, comprehensive monographs. It deals largely with the structure, sources, and reactions of the alkaloids of the pyrrolidine, pyridine-piperidine, isoquinoline, morphine, quinoline, and indole groups. The alkaloids derived from *Erythrina americana* and colchicine, and the biogenetic relationships of the alkaloids, are treated in three final chapters. There is an adequate index.

DIE CHEMIE DER NATÜRLICHEN ALKALOIDE, *mit besonderer Berücksichtigung ihrer Biogenese. Part 2.*

By Gertrud Woker. Ferdinand Enke Verlag, Stuttgart. (paper). Pp. 449–732 + 1 folded chart. 1956.

This volume is the second of a continuing series. Ten pages discuss the alkaloids with 2 free α side-chains (*Lobelia* alkaloids). Another 40 pages are devoted to alkaloids with 1 β and 1 cyclic α-α' side-chain (*Coca* alkaloids). The remaining 200 pages discuss the alkaloids which are derived from phenylaminopropionic acid, tyrosine, and the oxytyrosines.

PROTEOLYTIC ENZYMES AND THEIR CLINICAL APPLICATION. *Ann. N. Y. Acad. Sci., Vol. 68, Art. 1.*

By Gustav J. Martin and 37 other contributors. The New York Academy of Sciences, New York. $3.50 (paper). 244 pp.; ill. 1957.

The conference of which this volume is the proceedings was held on Nov. 8 and 9, 1956. The series of 22 papers is divided into 9 Laboratory Studies (Part I), and 13 Clinical Studies (Part II). The former provide an insight into current research on the chemistry of those enzymes which have so far been most useful clinically. These enzymes are mainly depolymerases, and appear to affect tissue permeability. The principal enzymes considered include trypsin, chymotrypsin, streptokinase, plasmin, and plasminogen. Part II presents papers on the use of various proteolytic and fibrinolytic enzyme preparations such as therapeutic anti-inflammatory agents in a variety of conditions such as cellulitis, abscess, phlebitis, burns, wound infections, and bursitis.

The meeting apparently was a stimulant to its chairman, Gustav J. Martin, who, in 1958, edited *Clinical Enzymology* (*Q. R. B.*, 34: 175. 1959). This book is patterned after the 1956 conference which seems to have served as a nucleus for its development. The conference papers are of special interest to any reader who wishes to learn something of the medical use of enzymes.

EUGENE W. RICE

BIOCHEMISTRY AND SOME PEPTIDE AND STEROID ANTIBIOTICS. *CIBA Lectures in Microbial Biochemistry.*

By E. P. Abraham. John Wiley & Sons, New York; Chapman & Hall, London. $3.00. xii + 96 pp.; ill. 1957.

Two families of antibiotics are discussed in this book: the bacitracins and the cephalosporins. In both cases the author's attention is almost wholly restricted to the elucidation of their structure. A final chapter deals with the chemical and functional relationships between these antibiotics and other microbial products: cephalosporin P_1, helvolic acid, and other fungal steroids; the several bacitracin polypeptides and the antibiotic micrococcin P; cephalosporins N and C, and other penicillins. References and an index are included.

CAROTENE. *Its Determination in Biological Materials.*

By V. H. Booth. W. Heffer & Sons, Cambridge. $2.52. viii + 119 pp.; ill. 1957.

But for the brief discussion of the chemistry of the carotenoids, this volume is a detailed presentation and evaluation of methods for the extraction and determination of carotenoids.

(1) DIE ASCORBINSÄURE IN DER PFLANZENZELLE; (2) VITAMIN C IN THE ANIMAL CELL. *Protoplasmatologia, Band II.*

By (1) Helmut Metzner; (2) G. H. Bourne. Springer-Verlag, Wien. $11.90 (paper). iv + 159 pp.; ill. 1957.

These two reviews of the function of ascorbic acid in plant and animal cells, respectively, are bound as a single number of this handbook series. In both cases the authors have attempted to present a comprehensive picture in so far as work pertaining to either the distribution or function of ascorbic acid is concerned. The reviews clearly are written by biologists rather than by biochemists. In each instance some discussion of both chemical and histochemical methods for the detection and quantitation of ascorbic acid is presented, and this is followed by a systematic consideration of the distribution of ascorbic acid in various tissues and cell types in the major groups of plants and animals.

G. H. Bourne's review, the more extensive of the two, also considers the distribution of ascorbic acid in various stages of development of the chick embryo, as well as its distribution in various pathological and experimental conditions.

For the experimental scientist interested in ascorbic acid, both of these review articles should effectively bring one up to the date of publication in so far as the literature on the topological histochemistry, general biochemistry, and physiology of ascorbic acid is concerned. It should be noted that the price of the monograph is fixed at a cost of 7.3 cents per page, close to an all-time record.

RONALD R. COWDEN

SOME ASPECTS OF THE CHEMISTRY AND TOXIC ACTION OF ORGANIC COMPOUNDS CONTAINING PHOSPHORUS AND FLUORINE.

By Bernard Charles Saunders; foreword by Sir Alexander Todd. Cambridge University Press, New York and London. $6.00. xvi + 231 pp. + 2 pl.; text ill. 1957.

As indicated by the subtitle, the material in this book deals with the chemistry and the toxicity of certain compounds of phosphorus and fluorine. Being derived from a series of lectures, the book lacks unity. Its contents include: Nomenclature of phosphorus-containing esters; drugs and the mammalian central nervous system; preparation, properties, and pharmacology of the phosphorofluoridates; some chemical reactions of phosphorus-containing esters; fluoroacetates and other compounds with carbon-fluorine links; insecticides; and the determination of fluorine in organic compounds.

HISTOCHEMICAL TECHNIQUE.

By W. G. Bruce Casselman. John Wiley & Sons, New York; Chapman & Hall, London. $3.25. 205 pp.; ill. 1959.

This new addition to the Methuen Biological Monograph Series should arouse some enthusiasm. The author has attempted the awesome task of covering in a general way that body of technique known as histochemistry. The scope and objectives of histochemistry are briefly discussed, and the principal methods for the localization of the major classes of macromolecules and the theoretical bases of these reactions are then given. A short special section on enzyme localization and on iron and calcium is also presented. Because of the limited size of the book, a comprehensive coverage of the methods to be found in the literature is not attempted, but instead selected methods are given. It is to these choices that one might take some exception; yet in an area that is developing as rapidly as histochemistry, such differences of opinion could scarcely be held against the author.

The particular value of this book lies in its forming a bridge between the methods of classical microscopical morphology and the more sophisticated histochemical and cytochemical methodology of the present. It makes an excellent starting-point for a student or a classical morphologist who wishes to extend the meaningfulness of his microscopic investigations. It should, however, be considered a prelude to more comprehensive reading.

RONALD R. COWDEN

METHODS OF TESTING CHEMICALS ON INSECTS. *Volume 1.*

By Harold H. Shepard. Burgess Publishing Company, Minneapolis. $5.00. viii + 356 pp.; ill. 1958.

Most of the articles are sufficiently indicated by their titles: use of isotopes (A. W. Lindquist); methods of studying resistance (W. V. King); topical application and injection methods (R. L. Metcalf); ingestion methods (F. W. Fisk); dipping methods (A. H. McIntosh); spraying methods (C. Potter and M. J. Way); dusting methods (J. E. Dewey); fumigant testing (R. T. Cotton); and measurements of blood properties (R. L. Patton). There are in addition several articles concerned with more general topics of physiology: the properties of cuticle (two articles, by W. M. Hoskins and A. G. Richards, respectively); insect respiration (R. Craig); electrophysiological preparations (K. D. Roeder and E. A. Weiant); and synergism and antagonism (N. Turner). The subject will be continued in at least one more volume.

MICROBIOLOGY

PERSPECTIVES IN VIROLOGY. *A Symposium.*

Edited by Morris Pollard. John Wiley & Sons, New York; Chapman & Hall, London, for the Institute of Microbiology, Rutgers University, New Brunswick. $7.00. xx + 312 pp. + 2 pl.; text ill. 1959.

This volume contains the proceedings of a symposium which took place in New York in February, 1958. The 12 chapters represent contributions of as many different authors, whose interests and research range from plant and bacterial viruses to those infecting animal and human hosts. It is the latter subject that receives the major emphasis in this volume.

The first chapter, by H. Fraenkel-Conrat, reviews the TMV-RNA infectivity story and presents some comparative studies on the mechanism of RNA infection as compared to that of intact TMV infection. N. Zinder discusses lysogenic conversions and points out that the *Salmonella* antigen-1, an antigen making its appearance on the surface of the bacterial cell following lysogenization, appears very speedily indeed, perhaps only 8 minutes being required after infection.

There follow two chapters on tissue culture, and its relation to animal virus study, by H. Eagle and T. Puck respectively. A dominant theme of the entire collection is the relation between viruses and cancer. As R. J. Huebner forcibly asks in Chapter 8: "Why is the concept that cancer in man may be due to viruses such a difficult one to accept?" The answer, of course, is that as yet no human tumors can be demonstrated to be virus-induced. Against this, however, and well documented in this volume are examples of virus-induced cancer in rabbits, rats, mice, frogs, chickens, and insects. It is enlightening to note that there are now over 90 accepted viruses infecting humans, 70 of which have been discovered in the last 10 years! Chapter 12 on Viral Neoplasia represents the combined effort of S. Beard, C. Friend, S. Stewart, B. Eddy, and K. Endicott. It is well documented with tables and color plates and should be of considerable value to the student of this subject.

The collection is brought to a close by a delightful article by Réné Dubos on the Tulipomania which swept Europe during the 17th century. This was not a disease but a wave of enthusiasm for tulip culture and commerce. Oddly enough, this subject has a viral etiology, as the reader will discover.

CHARLES A. THOMAS, JR.

VIRUS GROWTH AND VARIATION. *Ninth Symposium of the Society for General Microbiology, held at the Senate House, University of London, April 1959.*

Edited by A. Isaacs and B. W. Lacey. Cambridge University Press, New York and London. $7.00. viii + 272 pp. + 29 pl.; text ill. 1959.

The second (1952) Symposium of the Society for General Microbiology was also concerned with the nature of virus multiplication. In the interim, the expansion of knowledge regarding bacterial virus growth and nucleic acid chemistry, coupled with rapidly improving tissue culture and virus assay manipulations, has stimulated investigations of the growth, at the cellular level, of an increasing number of viruses. The current symposium reviews for the specialist the present status of these investigations. Animal viruses receive most attention, although bacteriophages (E. Kellenberger) and plant viruses (B. D. Harrison) are represented by excellent general reviews.

Animal virus research is taking parallel pathways in individual laboratories, each one utilizing its own "pet" virus. The application of a wide range of experimental techniques under rigid one-step growth conditions is beginning to outline some critical steps in virus growth in animal cells. Perhaps the outstanding contribution on animal viruses in the symposium is a report, by W. Schäfer, on the structure and growth of EE and of fowl plague myxovirus, two ribonucleoprotein viruses. Discussions by M. G. P. Stoker, on the herpes virus, and by H. Rubin, on the Rous sarcoma virus, are also quite illuminating. Some still scattered, pioneering experiments receive more general reviews, by G. K. Hirst (animal virus genetics) and P. D. Cooper (biochemical and tracer studies). Electron microscope observations are summarized by C. Morgan and H. M. Rose.

As S. E. Luria indicates in his introductory remarks, virus research is no longer restricted to a role ancillary to pathology and medicine, although these facets remain and are being expanded. Virology is in addition becoming a powerful branch of cellular biology. A wealth of very obvious, quantitative experimentation remains to be done on animal virus structure and on intracellular growth. These studies, along with clonal analyses of tissue culture populations, are entering a stage of development which could carry them to the very forefront of theoretical biology by the time of the next Society symposium on this subject.

PHILIP E. HARTMAN

VIRUS.

By Wolfhard Weidel. The University of Michigan Press, Ann Arbor. $4.50. 159 pp.; ill. 1959.

Weidel's introduction to viruses was designed for the layman and the teen-age student with an interest in biology. At times Weidel ingeniously presents the application of scientific method to the unraveling of puzzles basic to biology and at the center of his, and other virologists' research attentions. Most of the time, however, Weidel seems to doubt whether the exciting topics he is discussing will actually prove exciting to the reader. He rarely goes straight to the point, so as to put the virus itself, rather than the use of the superlative, in the spotlight. Lotte Streisinger's lively translation of a book first published in German (1957) has Americanized the abundance of sugary, painfully nonscientific jargon in the original and has preserved the numerous digressions from the main thread of the presentation. A number of long-winded analogies, which could have been replaced advantageously by a few simple diagrams, tend to dim otherwise striking concepts. However, in spite of Weidel's seeming attraction for the vogues of present-day research interests, the scientific content of the book is accurate. Wherever these contributions to our knowledge of viruses may have come from the reader is left to surmise, for in the entire text the only names mentioned are those of Leeuwenhoek, Lysenko, Pasteur, and Stanley. Most alarming for a book of its character is the absence of any clues to enable the reader to learn where to go next, should he become interested in some particular aspect of the discussion; in fact, the reader is even discouraged from doing so by the manner in which the writer has rounded all phases of the general subject into a too neat, one-dose capsule.

PHILIP E. HARTMAN

ANTISEPTICS, DISINFECTANTS, FUNGICIDES AND CHEMICAL AND PHYSICAL STERILIZATION. *Second Edition. Edited by George F. Reddish. Lea & Febiger, Philadelphia.* $15.00. 975 pp. + 134 tables; ill. 1957.

This large handbook of sterilization agents and methods has 28 reputable contributors, each of whom has written one or more chapters of the reference work. The developments in this field are taking place so rapidly that the second edition follows close on the heels of the first, after an interim of only 3 years. New chapters are included on sanitizing and bacteriostatic chemicals (L. S. Stuart), tests for sterility and methods of assuring the sterility of pharmaceutical and related preparations (J. H. Brewer), and ultraviolet irradiation in industry and public health (I. L. Shechmeister). New material has also been included on iodophors and the use of iodine solutions during catastrophes, the evaluation of phenolic disinfectants, quaternary ammonium compounds, the chemical disinfection of surgical instruments, new aspects of gaseous sterilization, and the use of sorbic acid, antibiotics, and derivatives of para-hydroxy-benzoic acid as food preservatives. The Index (10¼ pages) seems very brief for a reference work of this magnitude, but otherwise

reference is aided by the organization of the volume into distinct parts: Introduction; Methods of Testing; Antiseptics; Disinfectants; Fungistats and Fungicides; Preservatives; Chemical and Physical Sterilization; and Pasteurization. Each chapter is provided at its end with a list of major references, varying in up-to-dateness. This work will doubtless remain a standard reference in its field for several years to come, although it will require repeated revisions to keep pace with the advances in methods and the changes in fashions that mark the field of sterilization.

PARASITOLOGY

AN ILLUSTRATED LABORATORY MANUAL OF PARASITOLOGY. *Fourth Edition.*

By Raymond M. Cable. Burgess Publishing Company, Minneapolis. $2.75 (paper). xvi + 165 pp.; ill. 1958.

LABORATORY ESSENTIALS OF ANIMAL PARASITOLOGY.

By Marvin C. Meyer and Lawrence R. Penner. Wm. C. Brown Company, Dubuque. $2.50 (paper). xii + 103 pp. + 7 pl.; text ill. 1958.

Both of these manuals restrict their attention to protozoan, helminth, and arthropod parasites of animals; and both emphasize the morphology, life cycles, and identification of the parasites. Cable's manual is larger than the other and contains many more illustrations, tables, and keys; the latter, being difficult to find in many cases, will be much appreciated. The manual of Meyer and Penner is a first edition; Cable's is a revised (4th) edition.

STUDIES ON THE EXO-ERYTHROCYTIC CYCLE IN THE GENUS *Plasmodium*. *London School of Hygiene and Tropical Medicine, Memoir No. 12.*

By R. S. Bray. H. K. Lewis & Co., London. £2 2s. viii + 192 pp.; ill. 1957.

The development of saurian, avian, and mammalian plasmodia in cells of the host other than erythrocytes is the subject of this book. It is a review of the literature as well as a presentation of original work. Historical and taxonomic aspects are discussed in some detail. The work has an index and an extensive bibliography.

HEALTH AND DISEASE

BIOLOGICAL ASPECTS OF THE TRANSMISSION OF DISEASE. *Edited by C. Horton-Smith. Published for The Institute of Biology by Oliver & Boyd, Edinburgh and London; Hafner Publishing Company, New York.* $4.00. viii + 184 pp. 1957.

This book is based upon a symposium organized by the Institute of Biology. The editor, C. Horton-Smith, states that one of the objectives of the Institute is to break down barriers between diverse biological fields. This symposium must have achieved considerable success in that aim, for the contributors represented specialists in medicine, virology, bacteriology, mycology, protozoology, botany, and other related disciplines. There were 22 contributors, each of whom presented a short résumé of the epidemiological (or ecological) factors responsible for the survival and dissemination of organisms pathogenic to plants and animals. Some of these contributions are primarily factual summaries while in others there is considerable speculation as to reasons for poorly understood phenomena.

P. C. C. Garnham, in discussing the specificity of malaria parasites for certain species and genera of mosquitoes, shows that in non-susceptible species the factors of immunity may inhibit the formation of the ookinete or prevent its penetration, or the oocysts may fail to mature properly, or if sporozoites are formed, they may be lysed. It is interesting to note that no explanation can be given for these different expressions of immunity. There is still much to be learned of basic host-parasite relationships from the malaria parasites, but the opportunities are being overlooked because of the general opinion that the study of malaria is no longer fashionable.

H. C. Andrewes, who speculates on the evolution of the viruses and presents arguments for and against their origin in insects, points out that speculation is uncertain until we know *all* of the natural histories of the viruses.

This little book is useful as a compilation of what is known concerning the complexities of the natural histories of infectious organisms. The final section presents the discussions that followed the presentation of the contributed papers. Although many interesting points are brought out in them, it is unfortunate that they do not follow in their proper sequence at the end of each paper.

L. E. ROZEBOOM

ANNUAL REVIEW OF MEDICINE. *Volume 10. Edited by David A. Rytand; William P. Creger, Associate Editor. Annual Reviews, Palo Alto.* $7.00. viii + 448 pp.; ill. 1959.

The high standard of excellence of previous members of this series has been maintained in the tenth volume. The individual reviews are as follows: Some aspects of salmonellosis (I. L. Bennett, Jr. and E. W. Hook); Gastroenterology (J. B. Kirsner, J. E. Dooley, G. E. Scott, and S. C. Kraft); Diseases of the cardiovascular system, excluding hypertension atheroscle-

rosis (F. D. Johnston); Atherosclerosis (W. Dock); Diseases of the cardiovascular system—surgical (D. E. Harken and W. J. Taylor); Nutrition and nutritional diseases (G. H. Berryman); Endocrinology—diabetes (H. T. Ricketts); Endocrinology—Reproduction (R. L. Landau); Endocrinology—Surgery of the endocrines (J. D. Hardy); Allergy and immunology (W. B. Sherman); Cancer (C. Oberling); Tumor chemotherapy (R. L. Clark, Jr. and W. W. Sutow); Diseases of the nervous system (R. N. DeJong); Psychiatry (T. A. Gonda); Transfusions (S. C. Finch); Diseases of the skin (S. W. Becker, Jr.); Noncardiac anomalies (M. M. Ravitch and R. J. Wilder); Diseases of the respiratory system (R. S. Mitchell and G. C. Bower); and Environmental medicine (R. A. Kehoe, L. H. Miller, A. Davis, and M. Zavon).

VICTOR A. MCKUSICK

ERYTHROBLASTOSIS FETALIS *including Exchange Transfusion Technic. New England Journal of Medicine, Medical Progress Series.*

By Fred H. Allen, Jr. and Louis K. Diamond. Little, Brown and Company, Boston and Toronto. $4.00. xii + 143 pp.; ill. 1958.

The authors have investigated and treated erythroblastosis fetalis for some years. They address the book to fellow physicians; consequently clinical and practical considerations are emphasized.

THE EPILEPTIC SEIZURE. *Its Functional Morphology and Diagnostic Significance.*

By Cosimo Ajmone-Marsan and Bruce L. Ralston. Charles C Thomas, Springfield. $6.00. xii + 251 pp.; ill. 1957.

This volume, by authors at the National Institutes of Health, Bethesda, Maryland, bears the further subtitle, A Clinical-electrographic Analysis of Metrazol-induced Attacks. This title indicates the nature of the study, which was to induce attacks with metrazol and then follow the attack pattern and propagation of the discharge electroencephalographically. A total of 119 patients experiencing 153 induced seizures constituted the material. The discussion is a highly technical one, but is certain to be of interest not only to neurologists and clinicians concerned with epilepsy, but also to psychologists and neurophysiologists.

THE PHYSIOPATHOLOGY OF CANCER. *Second Edition. Edited by Freddy Homburger; foreword by Joseph C. Aub. A Hoeber-Harper Book, New York.* $33.00. xx + 1180 pp.; ill. 1959.

In this new edition of an established reference book, the authors have again brought together in one unabridged volume all pertinent present-day knowledge in each of the various fields of cancer research. In this present tome the contributors have been increased to 32, all well-recognized authorities, and each contributor has continued the excellent objectivity that was evident in the first edition, so that once again an informative working analysis of the latest progress in cancer research is presented.

There have been extensive revisions and a great deal of new material inserted since the first edition was published. In addition, there are several new chapters, including such topics as genetics, transplantation, experimental leukemia, etc. The excellent first edition organization has been carried over to this present volume, namely the division of the subject into 4 main parts: biology, chemistry, physics and clinical investigation, and practical applications. The reader is still led from the basic studies through the problems of clinical investigation, to the practical applications, and finally to the results of basic research reflected in the diagnosis and treatment of cancer.

Despite the more than one hundred per cent increase in price, *The Physiopathology of Cancer* is a reference book that must be studied by all who are interested in the broad field of cancer.

ROBERT G. CHAMBERS

THE CLINICAL EVALUATION OF NEW DRUGS.

Edited by S. O. Waife and Alvin P. Shapiro. A Hoeber-Harper Book, New York. $7.50. x + 223 pp.; ill. 1959.

This is an important volume outlining standards for drug evaluation, a matter which has had too little discussion, whether among pharmacologists, drug manufacturers, clinicians, or the public. There have been sporadic attempts to establish some general standards for drug evaluation. Merely in order to keep the record complete, some of these should be noted: Pharmacological Evaluation of New Drugs, *J. Amer. med. Assoc.*, 93: 1632–1634, November 23, 1929; W. Van Winkle, R. P. Herwick, O. H. Calvery, and A. Smith: Laboratory and Clinical Appraisal of New Drugs, *ibid.*, 126: 958–961, December 9, 1944; and Current Pharmacology: General Principles and Practical Clinical Application, *ibid.*, 138: 730–737, November 6, 1948. The extensive studies by H. K. Beecher and his pupil, L. Lasagna, on the measurement of placebo responses really focused attention on the over-all problem of standards for evaluating new drugs.

This volume is organized in two parts, the first dealing with principles of drug evaluation, and the second concerned with clinical trials in practice. The latter considers the appraisal of drug action in cardiovascular disorders, intestinal diseases, infectious diseases, nutrition and metabolism, endocrinological problems, and neuropsychiatric disorders.

S. O. Waife, Director of medical editorial work for the Lilly Research Laboratories in Indianapolis, opens the volume with comments on the life history of new drugs, and notes on research agencies concerned with new drugs. K. H. Beyer discusses pharmacological problems, while E. L. Severinghaus considers the transition from findings on animals to possible activity in humans. L. Lasagna and P. Meier review experimental design and statistical problems, while H. K. Beecher discusses placebos and the evaluation of the subjective response. W. B. Bean, writing brilliantly as usual, considers the ethics of experimentation on humans. The technical aspects of human experimentation are discussed by Stewart Wolf. D. J. Ingle reviews standards for the training of investigators, while A. P. Shapiro analyzes the personality of drug investigators. The volume closes with a short discussion by S. O. Waife on the problems of publication. The book is skilfully organized, well documented, and has a useful index.

CHAUNCEY D. LEAKE

HANDBOOK OF TOXICOLOGY. *A Compendium. Volume III: Insecticides.*

By William O. Negherbon. The National Academy of Sciences—The National Research Council; W. B. Saunders Company, Philadelphia and London. $14.00 (paper). xxvi + 854 pp. 1959.

HANDBOOK OF TOXICOLOGY. *Volume IV: Tranquilizers.*

Edited by Rudolph M. Grebe. W. B. Saunders Company, Philadelphia. $4.00 (paper). viii + 120 pp. 1959.

HANDBOOK OF TOXICOLOGY. *Volume V: Fungicides. Edited by Dorothy S. Dittmer. W. B. Saunders Company, Philadelphia.* $5.50 (paper). x + 242 pp. 1959.

Of these volumes, Numbers IV and V resemble the earlier volumes (I and II) of what is said to be a continuing series. In other words, they display both the merits and faults of a largely tabular presentation.

A section is devoted to each of 26 drugs in Vol. IV; most, but not all of these (e.g., amphetamine and isoproniazid), are tranquilizers. Typically one or more paragraphs are included under each of the following headings: formula; structure; physical and chemical properties; pharmacology; clinical; toxicity; mode and site of action; and references. An index includes the alternative names of the compounds.

Vol. V discusses 196 of the more effective fungicides in sections which average about a page in length. The material is arranged according to the following categories: other names; molecular and structural formulae; physical and chemical properties; tests; toxicity; source; use; comparative toxicology; phytotoxicity; and cautions. Also included are an index with alternative names, a bibliography, and a list of patent numbers. An especially valuable feature is the list of other compounds having fungicidal properties, for which appropriate references are cited.

Volume III is a distinguished attempt not only to tabulate an immense amount of data, but also to evaluate, interpret, and summarize it. Considerable ingenuity has been displayed in matters of organization; even the tables demonstrate the care given to the method of presentation, most of them being especially suited to the particular subject. Whenever it seemed more appropriate, the tabular arrangement was discarded, and articles, paragraphs, outlines, or a series of numbered sentences were substituted. Altogether, the volume is a fine and thoughtful piece of workmanship. There are 188 sections, of which 164 deal with specific insecticides which have proven useful or appear likely to become so. The remaining sections treat the chemical families of insecticides and such general topics as fumigants, bees (to exemplify the action of insecticides on beneficial insects), insecticides which are systemic in the host plant or animal, synergism, resistance, and insecticidal plants. These topics are treated commendably, but some of the others are so brief as to be useless (repellents; termites; mosquitoes) or lack interpretation and summarization (temperature and insecticide action; miticides; phytotoxicity). These criticisms are trivial beside the merits of the volume as a whole. There are indices to chemical compounds and to the scientific and common names of plants and animals, and a bibliography which is arranged alphabetically according to author.

DAVID R. EVANS

REMEDIES AND RACKETS. *The Truth About Patent Medicines Today.*

By James Cook; introduction by Oliver Field. W. W. Norton & Company, New York. $3.75. 252 pp. 1958.

This volume continues the sort of exposé of patent medicine exploitation which was the responsibility for many years of the Bureau of Investigation of the American Medical Association, and which culminated in a series of volumes called *Nostrums and Quackery*. James Cook writes in a clear, vigorous, journalistic style, and gives the essential information on the abuses inherent in "our billion dollar medicine show." There is a short chapter on the history of American drug quackery and the efforts to control it, and then a series of discussions on

flagrant examples of current TV exploitation, such as "tired blood," the aspirin contest, arthritic advertising, vitamin bunk, tricks and salesmanship, cold cures, reducing pills, laxatives, drug prizes, cancer, and a summary chapter suggesting increased public skepticism and sophistication as the best way of controlling drug exploitation. There is a short bibliography and a good index.

CHAUNCEY D. LEAKE

PSYCHOLOGY AND ANIMAL BEHAVIOR

AUS DEM LEBEN DER BIENEN. *Sixth Edition.* *By Karl v. Frisch. Springer-Verlag, Berlin, Göttingen, and Heidelberg.* DM 8.80. viii + 179 pp.; ill. 1959.

This new edition of *The Life of Bees* is a welcome addition to the literature about honeybees. More than that, it is a book which ranks among the short classics of biology. There have been numerous books on honeybees, in the 19th century for example, Lubbock's, and in our own time for example, Butler's *The World of the Honeybee*, Ribbands' *The Behaviour and Social Life of Honeybees*, von Frisch's own *The Dancing Bees*, and Khalifman's *Bees*. *The Life of Bees* is different from these in two respects: it is not an exhaustive treatise on bees; and it is told in a narrative style which loses no authenticity in the telling. To those familiar with the earlier edition, the present one needs no detailed description. It has been extensively rewritten. A great deal of new information with regard to orientation and dancing has been added. The better illustrations from the older edition have been retained and new ones added. Some have already appeared in *Bees* (Cornell Univ. Press).

The Life of Bees is unique in that it is as much the story of von Frisch's scientific life as it is the life of honeybees. A book such as this is one of the most powerful arguments for the study of German by graduate students in biology.

V. G. DETHIER

EVOLUTION OF NERVOUS CONTROL FROM PRIMITIVE ORGANISMS TO MAN. *A Symposium organized by the Section on Medical Sciences of the American Association for the Advancement of Science and presented at the New York Meeting on Dec. 29–30, 1956. Publ. No. 52.*

Edited by Allan D. Bass. American Association for the Advancement of Science, Washington, D. C. $5.75; ($5.00, AAAS Members). viii + 231 pp.; ill. 1959.

This collection of nine papers merits the usual remarks flung at such a mosaic. The coverage is spotty; the quality is uneven; the ordering thread of the title has little influence on the intellectual beads gathered; publication is very delayed. Nonetheless, this is a good and instructive volume of exciting range and content, on the whole skilfully presented. With a range of topics extending from chemical inducers of embryonic development (M. C. Niu), to I. A. Mirsky's experimental approaches to psychoanalysis, no one reader is likely to find many chapters outdated or trite. On the contrary, most of them offer excellent reviews of important areas to the non-specialist.

Between embryology and human behavior, and an orienting essay by E. W. Sinnott relating development and behavior, there stand two papers at the neurophysiological level, two more which are chemical in orientation, and two that are mainly behavioral. The chapters by E. L. Prosser on comparative neurophysiology and by H. Grundfest on the evolution of conduction are both truly efforts to follow an evolutionary thread, the former on a broader base than the latter, which manages to be both more detailed and more sweeping in its assertions. G. B. Koelle well considers neurohumoral agents, with little concession to the flow of time; and I. H. Page presents brain chemistry with a strong time axis, but a historical rather than an evolutionary one, and points the forward end of it at God. Animal behavior under drugs is described by J. V. Brady along with the use of the quantitative lever-pressing techniques. And H. L. Teuber writes of objective tests of human behavior and the influence of brain damage on performance, disposing en route of several cherished beliefs.

The volume is hash—but good.

R. W. GERARD

THE BRAIN AND HUMAN BEHAVIOR. *Proceedings of the Association, Dec. 7 and 8, 1956, New York, N. Y. Res. Publ. Ass. nerv. ment. Dis. Volume XXXVI.*

Edited by Harry C. Solomon, Stanley Cobb, and Wilder Penfield. The Williams & Wilkins Company, Baltimore. $15.00. xii + 564 pp.; ill. 1958.

This book reports what transpired in 1956 during the 36th yearly meeting of the Association for Research in Nervous and Mental Disease. It contains 21 separate chapters contributed by such eminent students of brain function as Wilder Penfield (Functional Localization in Temporal and Deep Sylvian Areas); Herbert Jasper and Theodore Rasmussen (Studies of Clinical and Electrical Responses to Deep Temporal Stimulation in Men with Some Considerations of Functional Anatomy); Frederic A. Gibbs (Abnormal Electrical Activity in the Temporal Regions and its Relationship to Abnormalities of Behavior); and Frederic Bremer (Physiology of the

Corpus Callosum). It begins with one of the final theoretical contributions of Karl S. Lashley (Cerebral Organization and Behavior) and ends with a detailed report of an elaborate comparison of the behavior of human subjects who were intact, brain-damaged, stressed, or schizophrenic (Harold G. Wolff, Loving F. Chapman, William N. Thetford, Louis Berlin, and Thomas C. Guthrie: Highest Integrative Functions in Man during Stress). In between, one finds careful summaries of human and animal studies in which brain-waves, endocranial stimulation, drugs, and ablations were used separately or in combination in efforts to throw light upon the challenging brain-behavior problem. Each chapter concludes with a discussion of the foregoing material, and many of these discussions I found to be rich in new material and useful ideas.

Extraordinarily rapid strides have been made during the past ten years in our knowledge of brain anatomy, physiology, and chemistry. This book accurately portrays this ferment out of which the principles of how the brain works can conceivably soon emerge. The professional in the field will therefore find the book a landmark worthy of careful examination. For other readers, the going will often be rough as regards terminology, concepts, and detail. All true biologists should find interesting, however, the utterances of human patients who receive electrical stimuli in the depths of the brain where the "pleasure centers" lie.

ROBERT GALAMBOS

ANIMAL BEHAVIOR.

By John Paul Scott. The University of Chicago Press, Chicago. $5.00. xi + 281 pp.; ill. 1957. This book, designed for the general reader or prospective student, was written to answer the question of what the study of animal behavior is about. Through numerous examples of behavior, chosen from animals throughout the phyla, and from well-documented studies of domestic animals as well as common laboratory animals, the author provides an answer that will stimulate both types of readers. The diversity of behavioral examples selected admirably conveys the fact that animal behavior is an integral part of biology.

In a chapter on Social Behavior and Social Organization dealing with ants, chickens, grouse, ducks, sheep, goats, deer, and various primates, Scott includes some highly interesting studies on the process of socialization in dogs which were conducted in his own laboratory. According to his findings, there are four, roughly regular periods in the developmental history of puppies based upon important changes in social relationships—a *neo-natal period* from birth until the eyes open at about 10 days; a *transition period* from the time the eyes open until the animal first responds to sound, at about 20 days; a *period of socialization* which lasts until final weaning at 7 to 10 weeks; and a *juvenile period* from this time until the animal is first capable of mating behavior, which may occur at any time from six months to more than a year of age.

Of particular interest is the correlation of these developmental stages with the electrical activity of the puppy's brain as measured by the electroencephalograph. It was found that a newborn puppy shows almost no brain waves at all and no differentiation between waking and sleeping stages, but distinct differences between sleep and wakefulness appear almost exactly at the beginning of socialization. The brain waves take their final adult form between 7 and 8 weeks of age, close to the time of final weaning.

Although five chapters are devoted to the relationship of behavior to anatomy, physiology, ecology, genetics, and evolution, there is no implication that behavior should be studied only within the boundaries of these disciplines. In his chapter on Methods of Study the author urges that the primary phenomena to be studied in the science of behavior are those of the *behavior itself*. All observable behavior provides a basis from which structural and physiological processes and their modifications can be understood, and a vantage point from which to relate the animal to its environment, as well as vice versa.

Three additional chapters deal with Learning: The Effects of Experience; Intelligence: The Organization of Behavior; and Communication: The Language of Animals. Since these chapters combine methods and concepts utilized in psychological studies with those more familiar to the biologist, they afford the reader an important opportunity for comparison.

The entire book is well written, but several questions may be raised. In his chapter on Behavior and Evolution, the author clearly perceives the "need to extend our observation and experiments to a wide variety of species, after which it may be possible to state general laws and theories with a great deal more certainty and to use them as a real foundation for human knowledge." More attention could have been given, therefore, to already existing examples of the now numerous taxonomic studies of behavior in various animal groups which emphasize the species-specific nature of certain behavior patterns, and to some of the conclusions that have been drawn from them. Although an entire chapter is devoted to the evolution of behavior in Scott's book, the work as a whole might have benefited had he utilized phylogenetic comparisons of some of the behavioral phenomena he discussed in earlier chapters. Studied from a phylogenetic point of view, many of the so-

called behavioral exceptions turn out to be end-products of a continuous evolutionary process.

Again, in the first chapter on Animal Behavior and Human Behavior, the author states that "animal behavior can be a yardstick for human behavior" and that "the most important objective of the science is to develop general ideas and theories which explain the behavior of all animals including ourselves." But references to human behavior are almost confined to 2 pages on heredity and human behavior, and to 3 pages of general discussion dealing with human biology and the basis of social organization. Since the prospective student in psychology and sociology, as well as in biology, will be attracted to this book, some inclusion of the methods and findings of the psychoanalytic and psychosomatic disciplines would have provided a fairer, and thus more accurate, picture of the entire behavioral field.

The book is amply illustrated with photographs and interesting line drawings, and contains 14 valuable pages of recommended general and specialized readings of the various topics considered.

SOL KRAMER

BRAIN-MEMORY LEARNING. *A Neurologist's View.* *By W. Ritchie Russell. Oxford University Press, New York and London.* $4.50. xii + 140 pp.; ill. 1959.

In his Preface W. R. Russell notes that important advances in knowledge of how nerve cells operate "make it desirable to reconsider the so-called mental processes, in so far as these must depend on the activity of brain-cells." Reconsider these processes he does, bringing to bear on the problem a rich clinical experience. Material on concussion and traumatic amnesia is especially full, but findings and case reports involving epilepsy, head wounds, brain operations for pain, and the like are also well utilized. Moreover, in a pleasant effort at rapproachement, Russell is concerned to use psychoanalytic insights and fit them with his consideration of the brain. He correctly recognizes, for example, a close tie between Pavlov and Freud—as both of them explicitly recognized in statements to this reviewer. And he does give a "lightly-over" review of some recent neurophysiological findings. But "the activity of brain-cells" receives little real attention in this volume.

Russell's views come close to current neurophysiological thought on the reverberation of nerve impulses in closed neurone loops as a mechanism of fixing experience, and he almost comes to grips with fixation time; yet he seems unaware of the considerable laboratory research that has provided a solid basis for such matters. Indeed, after introducing some anatomical-physiological knowledge in the first part of the volume, the bulk of the monograph contains the sort of homilies and precepts that flow from extensive observation and rumination, rather than from experimental analysis. Most of these interpretations are sound, some are banal, while few depend on neurophysiology. And occasionally a pious exhortation to effort, in an area where great effort is now displayed, is even amusing. Russell is indeed firmly against sin when he writes, "It seems to the writer that the time is ripe for an extensive study aimed at the prevention of mental disease by turning attention more to the anatomical and physiological aspects. . . . It is entirely undesirable that the common fatalistic attitude to . . . mental disorder should be encouraged in any way" (p. 128).

R. W. GERARD

A TEXTBOOK OF PSYCHOLOGY. *By Donald Olding Hebb. W. B. Saunders Company, Philadelphia and London.* $4.50. x + 276 pp.; ill. 1958.

This volume is a succinct summary of some of the recent work in psychology by an author who has been profoundly influenced by neurophysiology and neuroanatomy. In a number of respects it differs from other recent textbooks which are aimed at the beginning student in psychology. The most important of these features are as follows: (a) Psychology is treated as a biological science. Basic problems in psychology—mental processes, heredity and learning, memory, motivation, perception, etc.—are discussed in terms of a neurophysiological theory of human behavior which the author has previously published (*Organization of Behavior*, John Wiley & Sons, New York, 1949; *Q. R. B.*, 26: 319. 1951). Complex human behavior is viewed as a function of "mind," which is in turn considered to be some part or aspect of brain activity. (b) The experimental evidence for the viewpoint presented draws heavily on the research of the author himself and his students.

This brief volume should prove of interest to many biologists. It presents an original theory and summarizes recent experiments which aim to make a rapprochement between psychology and neurophysiology. It also includes an interesting discussion of a relatively neglected factor in the development of behavior, namely, the *constant* sensory environment which is common to all members of a species. (In this context "instinctive" behavior is treated as a function of hereditary factors *plus* exposure to the normally present and relatively invariable stimulus patterns of the early environment.)

Nevertheless, Hebb's *Psychology* cannot be recommended for use by the beginning student. The attempted revivification of the concept of the "mind" and the speculative discussion concerning "cell assemblies," "phase sequences," and other mythical neurological entities are inappropriate in a primary text. More important, this volume neglects the mass

of data accumulated during recent decades by social psychologists, sociologists, and anthropologists, data strongly indicating that complex human behavior cannot be understood when the individual is removed from his social matrix and is treated as an isolated unit.

THEODORE X. BARBER

DIFFERENTIAL PSYCHOLOGY. *Individual and Group Differences in Behavior. Third Edition.*
By Anne Anastasi. The Macmillan Company, New York. $7.50. xii + 664 pp.; ill. 1958.

The third edition of this well-accepted textbook has been extensively revised. Although almost half of the research reviewed in this edition has been published since the earlier edition of 1949, the book has been condensed and more emphasis placed on basic methodological problems, significant concepts, and major findings.

This volume can be highly recommended not only for its intended reader, the second-year student in psychology, but for all workers in the behavioral sciences as well. Its outstanding feature is a critical review of the concepts and methods used in investigating the problems of heredity and environment, mental deficiency and genius, and the psychological differences associated with physical constitution, race, sex, social class, and culture. By emphasizing the sources of error in interpreting the results, the author succeeds in providing the reader with the necessary tools "whereby he may evaluate for himself a set of data with which he is confronted."

THEODORE X. BARBER

HUMAN BIOLOGY

OLD STONE AGE. *Art and Nature: a series.*
By Stevan Célébonovic; commentary by Geoffrey Grigson. Philosophical Library, New York. $10.00. 92 pp. + 72 photos. 1957.

The first of the Art and Nature Series dealt with *The Living Rocks* and their mineral and fossil treasures. The present one, the second in the series, is concerned with the beginnings of man in the Paleolithic Period, with his emergence from a pre-human state and, more especially, with the emergence of art in its earliest form. Once again the camera of Célébonovic brings to us, with consummate artistry, a pictorial history of man's attempt at imagery: flaked, etched, painted, and modeled. And Grigson's text ties the 70-odd photographs into a comprehensive, exciting, and intelligible whole. The result is a work of art in its own right.

Included among the illustrations are a few of the flint tools of early man, tools that go beyond mere usefulness and reflect the first conscious concern for form. There then suddenly appear on the scene the creatively sophisticated Aurignacian cave paintings of Spain and France, and the sculptured images of the somewhat later eastern Gravettian culture. The latter could easily pass today as the work of Henry Moore. Then came the polychrome ornamentations of the Magdalenians of the Pyrenees, and the paintings of Niaux. These have survived for thousands of years, and as Grigson states, "this is miracle enough." Altogether a beautiful volume!

C. P. SWANSON

PLEISTOCENE MAN AT SAN DIEGO.
By George F. Carter. The Johns Hopkins Press, Baltimore. $8.00. xvi + 400 pp.; ill. 1957.

In an addendum to this book, written in October 1956, the author accepts without question the presence of man in America on a time level beyond the (then) carbon-14 range; that is, more than 30,000 years ago. In view of this, and of a variety of data set forth in the body of the book, he claims that man was probably in America at the opening of the Wisconsin and possibly in the last interglacial period. These geological terms are given chronological substance in a chart on p. 370, where an unnamed and questionable lithic complex (consisting of bipolar cores—?, blades—?, and core tools—?) is assigned to the third interglacial stage of the Pleistocene and is given an age of 80,000–100,000 years (before the present). From this dubious beginning a definite, but still unnamed lithic complex, terminating in the La Jolla culture (consisting of biface and plano-convex cobble core tools, used flakes, mano and metate), is assigned to the early Wisconsin stage of the Pleistocene and is given an age of 55,000–80,000 years. These conclusions rest on extensive field work covering a period of 10 years, the results of which are now reported in considerable detail.

Judging from the anthropological literature and conversations with other anthropologists, Carter's claim for such a high antiquity for man in America, even though supported by so much geological and archeological evidence, has produced almost no excitement in the profession and mostly unfavorable reactions. This is largely due to skepticism about the nature of the chipping on the stones which Carter claims are man-made tools. Archeologists, and especially those of the Old World, are constantly being confronted with the problem of distinguishing the intentional and planned stone chipping produced by man from the often similar accidental chipping exhibited by stones which either have been subject to extreme temperatures or have struck one another while being moved by streams, waves, or glaciers. This being the case, and since man's presence in the San Diego area in a Pleistocene context rests largely

on the correct interpretation of the stone chipping, one would expect this matter to have been referred at the outset to experts in stone chipping. On the contrary, the identification of the chipping is Carter's alone. Although he sees parallels between his so-called stone tools and the ancient Soan tradition of stone-work in Asia, he has not sought confirmation of this from Old World specialists. Apparently he encountered early disagreement on this score and thereupon seems to have avoided endangering further his fundamental premise; or at least, this is my interpretation of passages such as the following: "In avoiding the citation of papers by co-workers because of the emotional impact of the claim for high antiquity for man in America . . ." (pp. 3–4 of Acknowledgments). "I choose not to cite individuals, since this has tended to bring on name-calling" (p. 183). "American archaeology has taboos. One of them has forbidden comparison of American lithic industries with Old World stone-work" (p. 367).

American anthropology has moved a long way from the conservative position regarding the antiquity of New World man which was widely held as recently as a quarter century ago. There is now general acceptance of the plentiful evidence of man's presence in the West 10,000–15,000 years ago. Although many would grant the likelihood of man's presence in the New World well before this time, they are inclined to look at the still scanty evidence critically and to reserve final judgment until more conclusive evidence has accumulated. Certainly no one is trying to hold back progress on this front, much less to prevent comparisons with the Old World stone-work. The fact that in spite of criticism Carter has been given so much institutional and financial support is evidence of this.

To return to the book itself, the first 100 pages deal with geomorphology; there follow 70 pages on climate and soil, 190 pages on archeology, and a summary of 15 pages. The 8-page bibliography, which omits most of the literature on ancient man in America, is followed by a 12-page index. The reviewer is unable to evaluate the geological data and soil analyses, but he is impressed by the assurance with which Carter ranges over these sciences, with so little help, at least in the field, from top-flight specialists. Involved here is another fundamental premise, namely, that the coastal area at San Diego has long been stable in the geological sense. The interpretation of terrace levels depends on this assumption, and thereupon in turn depends the local chronological structure to which the so-called "artifacts" are related. If the evidence of man's presence has been correctly interpreted, but the chronology incorrectly determined, then man may not have arrived in San Diego as early as claimed. On the other hand, if the evidence of man's presence is faulty, the chronology, whether correct or not, tells little about when man first appeared in San Diego.

The archeological section, in which the reviewer is more at home, baffled him for a while because of the seeming difficulty of locating the sites geographically; then he discovered that the endpieces serve this purpose. However, in the course of making this discovery he found that many of the archeological sections are not indexed. For example, the Sweetwater site is described on pp. 356–362, but the index references to it cease at p. 163. Aside from such minor faults, the reporting is straightforward, with only the criticism of the artifacts expressed above casting a shadow over the whole.

In fairness to Carter, it should be pointed out that he has mounted a broad attack on an important problem. Quite wisely he has recognized the need to integrate very diverse types of evidence. If he has failed, and time will tell, it is probably because he has tried to be an expert in too many fields.

T. D. STEWART

THE NEOLITHIC REVOLUTION.
By Sonia Cole. British Museum (Natural History), London. 5s. (paper). vi + 58 pp. + 18 pl.; text ill. 1959.

MARIANAS PREHISTORY. *Archaeological Survey and Excavations on Saipan, Tinian, and Rota. Fieldiana: Anthropol., Vol. 48.*
By Alexander Spoehr. Chicago Natural History Museum, Chicago. $4.50 (paper). 187 pp.; ill. 1957.

The survey emphasized pottery and stone artifacts, with some attention to shell, bone, and metal artifacts. Houses were of the latte type, one excavation of which is dated by carbon-14 at A.D. 845 ± 145.

THE POPULATION OF JAMAICA.
By George W. Roberts; introduction by Kingsley Davis. Cambridge, published for the Conservation Foundation at the University Press; Cambridge University Press, New York. $7.50. xxii + 356 pp. 1957.

A complete and well-organized demographic study, *The Population of Jamaica* considers first the historical growth of the population from the beginning of the colonial period and the days of slavery; then deals with population density, age structure, racial composition, sex distribution, educational status, and occupational status; and thereafter devotes two chapters to migration, external and internal. Mortality, Changing Patterns of Reproduction, Fertility, Mating and Illegitimacy, and future Growth Prospects

round out the treatment. Appendices give statistical information from the censuses since 1841, and on indenture immigration, and net emigration to the United States. The volume is one which will not only be indispensable to all demographers but will provide a fine background for any anthropologists or human geneticists concerned either with the peoples of the West Indies or the problems of racial intermixture.

CHEMICAL ANTHROPOLOGY. *A New Approach to Growth in Children.*

By Icie G. Macy and Harriet J. Kelly. The University of Chicago Press, Chicago. $3.75. xviii + 149 pp.; ill. 1957.

"Chemical anthropology" here means the changes in quantitative measures of physical, physiological, and chemical factors in human children as they progress from 4 to 12 years of age. Changes with age are reported for a huge number of variables; the several formed elements of the blood, blood chemistry, all externally measurable physical dimensions of the body, the volume of the fluid compartments, percentage of fat, retention of various nutrients, daily energy balance, gastric emptying time, and many others. The present book is an attempt to integrate and interpret a mass of such data which earlier was published in detail along with its statistical evaluation.

BIOMETRY

INTRODUCTION TO BIOSTATISTICS.

By Huldah Bancroft. A Hoeber-Harper Book, New York. $5.75. x + 210 pp.; ill. 1957.

To present an elementary, non-mathematical introduction to statistics for medical students was the intention of this textbook. Accordingly the examples and applications of statistics are largely medical. Life-table analysis and follow-up studies of chronic disease are two such applications which are discussed at some length.

DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION *Showing the Operations, Expenditures, and Condition of the Institution for the Year Ended June 30, 1957. Publ. 4314.*

Smithsonian Institution, Washington, D. C. $4.50. x + 499 pp. + 73 pl. + 1 folded chart; text ill. 1958.

The Annual Report of the Smithsonian Institution invariably contains many things of interest to biologists, and this volume is no exception. Here, for example, in the Report on the National Zoological Park, one learns that during the year 1957 "Gene," the now husky F_2 progeny of the cross between the Alaskan Brown Bear (*Ursus middendorffii*) and the Polar Bear (*Thalarctos maritimus*) has been joined by three young sibs. What a glorious opportunity for some aspiring geneticist to league with the keepers of the zoo in making informative back-crosses designed to study the segregation of intergeneric differences in the Carnivora! In addition, a hybrid has occurred among the gibbons, the parents being *Hylobates agilis* and *H. lar pileatus*. This is another cross assuredly of remarkable genetic and evolutionary interest. Reports of the United States National Museum, Bureau of American Ethnology, and Canal Zone Biological Area also present biological items.

Among the papers of broad general interest which have for years formed a special feature of the *Annual Report*, attention may be called in particular to four which are original publications: Pollen and spores and their use in geology (Estella B. Leopold and Richard A. Scott); The land and people of the Guajira Peninsula (Raymond E. Christ); Aniline dyes—their impact on biology and medicine (Morris C. Leikind); and Stone Age skull surgery (T. D. Stewart). Among the other papers, eight of biological general interest have been reprinted from a variety of sources: Science, technology, and society (L. R. Hafstad); The influence of man on soil fertility (G. V. Jacks); The nature of viruses, cancer, genes, and life (Wendell M. Stanley); Mystery of the red tide (F. G. Walton Smith); The return of the vanishing musk oxen (Hartley H. T. Jackson); Bamboo in the economy of Oriental people (F. Z. McClure); Mechanizing the cotton harvest (James H. Street); and Causes and consequences of salt consumption (Hans Kaunitz).

BENTLEY GLASS

THE DEMAND AND SUPPLY OF SCIENTIFIC PERSONNEL.

By David M. Blank and George J. Stigler. National Bureau of Economic Research, New York. $4.00. xix + 200 pp.; ill. 1957.

In this volume two economists have sought methods and data with which to estimate the supply of and demand for certain scientific personnel. These are mainly the engineers, but mathematicians, chemists, and physicists are considered at some length. Nothing is said of any other scientists! Data and the authors' interpretation of them are presented in regard to the following: the growth of organized research and research personnel, definitions and methods of estimating supply and demand, factors

influencing the demand for engineers and chemists, the supply of engineers, and the supply of and demand for mathematicians and physicists. There are also an index and several appendices which tabulate further data relevant to the above topics.

SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN. *A Handbook Compiled from Official Sources. 58th Edition.*

George Allen & Unwin, London. $2.52. 211 pp. 1956.

Several hundred various societies are catalogued in this volume under headings indicative of the area of knowledge to which they are devoted. The individual descriptions contain some or all of the following information: address, historical notes, objectives, physical facilities, membership, library facilities, and a schedule of meetings regularly held.

BRITISH SCIENTIFIC AND TECHNICAL BOOKS.

Foreword by F. C. Francis. James Clarke & Company, London; [Hafner Publishing Company, New York.] $11.25. xi + 364 pp. 1957.

This valuable work of reference contains a "select list of recommended books" published in Great Britain and the Commonwealth during the years 1935–52. Many of these will be recognized as books published first in the United States, or elsewhere in English, and then brought out in a British edition; but still at least half were published for the first time in Great Britain. The entries are classified by subject, and for the Biological Sciences, Botany, and Zoology the total amounts to 675 items. [That separation of Botany and Zoology from the "Biological Sciences" is truly puzzling.] Other biological works are included under Medicine, Agriculture, Palaeontology, etc. There is a full Author or Title Index, a Subject Index, and a List of Publishers with addresses.

THE PRESERVATION OF NATURAL HISTORY SPECIMENS. *Volume 1. Invertebrates.*

Edited and Compiled by Reginald Wagstaffe and J. Havelock Fidler; drawings by Elizabeth M. Begg. H. F. & G. Witherby, London. $10.00. xiii + 205 pp.; ill. 1957.

The authors have brought together in this work techniques which were heretofore scattered throughout the literature, and have added some unpublished methods. This volume and its proposed successor on vertebrates, plants, and geological specimens are intended as manuals for students. The invertebrates are treated in taxonomic sequence; for each group appropriate narcotizing, preserving, killing, fixing, staining, mounting, and storage methods are described and references given. Several appendices describe general apparatus, the composition of reagents, and further general methods.

COLLECTING, PRESERVING AND STUDYING INSECTS.

By Harold Oldroyd. The Macmillan Company, New York. $5.00. 327 pp. +15 pl.; text ill. 1958.

This book is primarily for the tyro entomologist of any age. That is not to say that the advanced amateur and the professional cannot read parts of it to their advantage. The title gives a fair indication of the contents. The first section seems, by its illustrations, to be directed to the youngster who is making his first collection. Most of the apparatus mentioned could be made by the boy himself, with a bit of adult help, and the general information which is included should insure a reasonably well-balanced collection. Much the same can be said of the section on insect preservation, although here some of the techniques given are perhaps a little advanced.

It is in the next section (Examining Insects) that the book definitely goes beyond the needs and possibilities of the average boy. Here are remarks on microscopes, special drawing apparatus, cameras, and photographic methods. This section, with the final third of the book, is for the young entomologist who is about to write his first paper. One may assume that he has reached the stage of the advanced amateur without any formal instruction[1] in entomology. The principles of zoological nomenclature, the position of insects relative to the rest of the animal kingdom, a brief characterization of the orders of insects, and a study of the making and use of keys (with excellent and much-needed observations on their limitations) are treated in succession. The text closes with some well-selected remarks on the preparation of manuscripts for publication.

In preparing such a book as this, it is a problem to decide what to include and what to omit. Naturally, an American author would produce a book differing from one by an English author, but the fundamentals covered would be the same. Each worker has his own favorite techniques to be advocated in preference to others as good or perhaps better. For example, I would myself like more stress laid on the use of cold KOH in the preparation of dissections. Many more valuable specimens have been ruined by overboiling than by too long immersion in a cold solution. However, each worker will perfect his own technique. On the whole, the book seems eminently satisfactory for its intended purpose.

EDWARD A. CHAPIN

PHOTOMICROGRAPHY. *Second Edition.*

By Roy M. Allen. D. Van Nostrand Company, Princeton, Toronto, London, and New York. $9.00. xiv + 441 pp. + 54 pl.; text ill. 1958.

Photomicrography is a book of great value to anyone interested in the craft of making photographs of microscopic material. It is a fine source book alike for the beginner and the advanced student of photomicrographic techniques. The information included is too extensive to list completely or even to outline. Included are a discussion of techniques, explanation of theories and practices, and examples of almost all existing systems which may be purchased as well as methods of constructing "homemade" equipment. Actually no information that would be useful to a beginner is not presented somewhere in this book; and the complete index makes extended searching for needed information unnecessary. There seems to be only one fault: the quality of the illustrative photomicrographs is often poor. Whether this is the result of inferior material, reproduction, or photographic technique it is hard to determine, but one can safely assume after reading the book, that it is not the latter. *Photomicrography* is a book that will prove valuable to anyone interested in such work.

TIMOTHY MERZ

SCIENTIFIC RUSSIAN. *A Concise Description of the Structural Elements of Scientific and Technical Russian.*

By George E. Condoyannis. John Wiley & Sons, New York; Chapman & Hall, London. $3.50 (paper). xii + 225 pp.; ill. 1959.

This book is designed to teach the student a working knowledge of scientific or technical Russian in a hurry. Although it will probably not succeed in its purpose, it is not certain that any other book could. One could certainly acquire a reading knowledge of Russian from it, but neither easily nor even rapidly. However, this book is excellent for reference purposes. All points of syntax seem to be touched upon in an authoritative fashion, especially the verb forms. These are covered in more detail here than in some other more advanced textbooks. There are many paradigms which will be quite helpful to the beginner. The price does seem to be a little excessive for a book whose loose-leaf binding is unlikely to stand up under the hard use to which it will be subjected.

MYRON L. WOLBARSHT

RUSSIAN FOR THE SCIENTIST.

By John Turkevich and Ludmilla B. Turkevich. D. Van Nostrand Company, Princeton, Toronto, New York, and London. $5.95. x + 255 pp. 1959.

Complete English translations of the more important Russian journals have been made during the last few years, and indexes and summary translations of many other Russian journals are also available. These furnish a window through which the non-Russian-speaking scientist can get a view of Soviet research. Through this window we see that the Russian scientist publishes his results in much the same format as we do. His methods are described in detail only in his first paper on any given subject, and later papers refer only briefly to those methods. The most recent papers have been translated into English, but many of the earlier papers containing the descriptions of the methods have not. This makes us aware of a dark shade obscuring much of the window through which we are trying to observe Russian science. John and Ludmilla Turkevich have written their book with the aim of lifting this shade and allowing us to look upon Russian science in its entirety—or at least so far as the research is actually published.

Scientific Russian is not a difficult language. Many of the technical terms are transliterations of English words. The sentence structure is usually simple, even though the language is a highly inflected one. The present book takes full advantage of these points to furnish an elegant introduction to the Russian language. The many tables and illustrations of equipment add to the book's value.

It would not be quite fair to entitle this book "Russian in Three Nights"—but if you wish to learn scientific Russian, it is certainly the best available guide.

MYRON L. WOLBARSHT

SCIENTIFIC GERMAN. *A Concise Description of the Structural Elements of Scientific and Technical German.*

By George E. Condoyannis. John Wiley and Sons, New York. $2.50 (paper). x + 164 pp. 1957.

SCIENTIFIC FRENCH. *A Concise Description of the Structural Elements of Scientific and Technical French.*

By William N. Locke. John Wiley and Sons, New York. $2.25 (paper). x + 112 pp. 1957.

These two pocket-size books are intended to serve the self-taught student of French or German who wants to acquire a reading knowledge of scientific prose in those languages. Both guides are quite similar in plan, starting with matters of pronounciation and devoting most space to grammatical difficulties and syntax—word order, irregular verbs, tenses, prepositions, plurals, gender of nouns, pronouns, interrogative expressions, the subjunctive, adjectives and adverbs, etc. All of this a college student might be expected to get in the first year of study of either one of these languages; but for the solitary learner or the student who wants to review the grammar there is much here that would be helpful. The student must not, of course, expect this type of aid to substitute either for the necessary accumulation of

a scientific as well as an ordinary vocabulary, or for the easy handling of construction that comes only with practice in reading.

SCIENCE AND THE DETECTION OF CRIME.

By C. R. M. Cuthbert. Philosophical Library, New York. $10.00. 244 pp. + 15 pl.; text ill. 1958.

The author of this thoroughly enjoyable and very instructive book is a former superintendent of the Metropolitan Police Laboratory of the New Scotland Yard. The 17 chapters recount the development, in a 23-year period, of the Forensic Science Laboratory of England's famous Criminal Investigation Department. Included are the stories of the development of fingerprints as a medicolegal investigative tool, and of the role of the physicist, biologist, and serologist in the identification of blood stains, hair and fiber studies, footprints, tire marks, and other physical evidence in the solution of famous crimes. Other sections are devoted to scientific evidence in fire and sabotage, questioned documents, and firearms identification cases. A chapter is devoted to a comparison of the British laboratories with those of some foreign countries, including the FBI laboratory of the United States.

The book is written for the lay reader, is illustrated with many of the true stories of famous English crimes, and challenges the reader to put it down without completing it once he begins. I for one could not. Despite its easily readable style, the complete familiarity of the author with all aspects of crime detection and the thoroughness of his coverage make the book a valuable reference work for the professional man in any field of forensic science.

RUSSELL S. FISHER

MISCHIEF IN PATAGONIA.

By H. W. Tilman. Cambridge University Press, New York and London. $3.75. 185 pp. + 16 pl. 1957.

This is a book of sailing and mountaineering, written in a conversational tone. It is well illustrated from photographs taken by the author, but contains a minimum of biological information about the still little-known parts of Chile and Argentina known as Patagonia. For naturalists planning an expedition to those parts, it should provide good background; for others, good general reading.

ANTARCTIC HAZARD.

By Ross Cockrill. Philosophical Library, New York. $4.75. 230 pp. + 13 pl. 1957.

It is quite surprising to find, year after year, so many narrative accounts of whaling. Is it indeed of such widespread interest? To the biologist reader these books have significance only in so far as they deal with the biology of the whales themselves, but it is rare that the scientific knowledge of the author extends so far as to permit an accurate classification of the kinds of whales observed. Common names are the rule, and the narrative focuses more on the excitement of the chase than on the ways of whales. This book is no exception to the rule, but it is very well illustrated with photographs taken by C. E. Ash (unidentified) and the author (?). Two chapters, entitled The Whale in Sickness—and in Health, include some interesting observations on whale parasites, internal and external, ambergris, the taste of whale's milk, and the like; but clearly the author's interest is not primarily in natural history.

BENTLEY GLASS

THE QUARTERLY REVIEW OF BIOLOGY publishes critical reviews of recent researches in all of the special fields of biological science. The contribution should present a synthesis or digest of the researches and a critical evaluation of them. A mere synopsis of the literature without evaluation or synthesis is not desirable.

Theoretical papers are published occasionally, especially when such papers (1) include a critical synthesis of the literature bearing on the theory and (2) are likely to promote further research in a given field.

The article should be written in concise language, yet in sufficiently non-technical form as to be intelligible not only to specialists in other fields but to the general biologist as well. To this end the article should have a general introduction and a summary which enumerates one by one all of the principal facts and conclusions given in the paper. Interpretative diagrams and schemes are very desirable.

Material ordinarily taking the form of footnotes is set in small print and placed in the text and consequently should be written in a style so as to fit readily into the text. Acknowledgments are printed in the text in small type at the end of the article just preceding the List of Literature. Recent issues of the Quarterly should be examined for style as regards (1) section or subsection headings in the text, (2) literature citations in the text, and (3) List of Literature.

The subjects and authors of articles are selected by the Editors and members of the Advisory Board. Unsolicited articles which conform with the objectives of the Quarterly will be considered for publication.

A feature of the REVIEW is the section dealing with *New Biological Books*. In this department the book literature of different countries in the field of Biology is given comprehensive and critical attention.

The QUARTERLY REVIEW OF BIOLOGY is issued in March, June, September and December.

The reprint order blank accompanying galley proofs gives the cost of reprints.

Manuscripts may be sent to Dr. H. B. Glass, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland.

Books for Review may be sent to Dr. H. B. Glass, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland.

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